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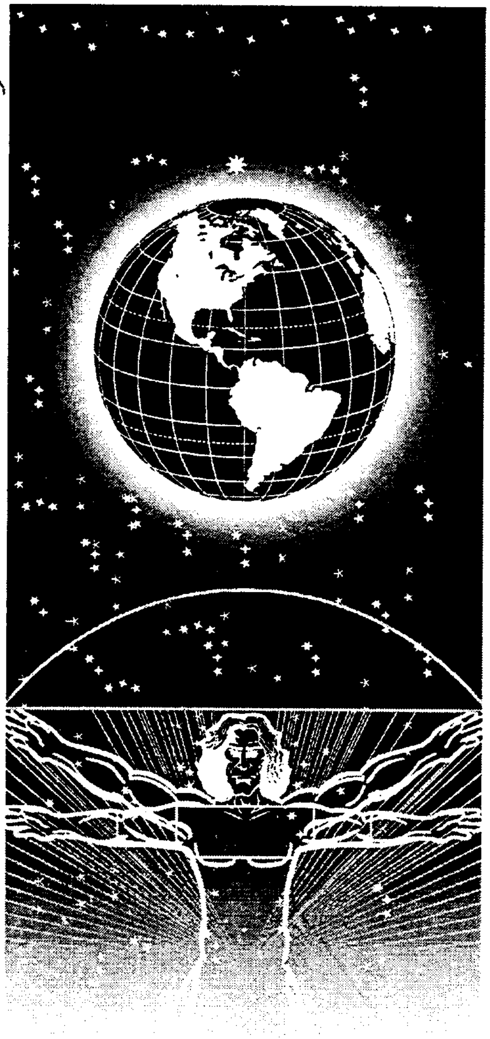

UNITED STATES AIR FORCE
IERA

Level I Ergonomics Methodology Guide Supplement for Warehouse and Service Areas

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The Level I Ergonomics Methodology Guide Supplement for Warehouse and Service Areas extends the applicability of previously developed United States Air Force (USAF) methodologies for the assessment and correction of ergonomic hazards to typical warehouse and service jobs. The Guide Supplement contains 20 case studies that describe risk factors for musculoskeletal disorders associated with warehouse and service work, and the control measures that can be used to eliminate or reduce these risk factors. The Guide Supplement is intended to be used by USAF Bioenvironmental Engineering technicians with minimal experience in ergonomics, to resolve potential ergonomic problems at their installations.

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ACRONYMS AND ABBREVIATIONS

AFB	Air Force Base
AFOSH	Air Force Occupational Safety and Health
BEF	Bioenvironmental Engineering Flight
EPRA	Ergonomics Problem Area
ESOH	Institute for Environment, Safety and Occupational Health
fc	Foot-Candle
IERA	Institute for Environment, Safety and Occupational Health (ESOH) Risk Analysis
JR/PD	Job Requirements/Physical Demands (Survey)
M/I	Maintenance and Inspection Work Areas
OSHA	Occupational Safety and Health Administration
PES	Pacific Environmental services, Inc.
PHF	Public Health Flight
PM	Preventative Maintenance
TJI/ADL	The Joyce Institute, a Unit of Arthur D. Little, Inc.
USAF	United States Air Force
WMSD	Work-Related Musculoskeletal Disorders
WPAFB	Wright-Patterson Air Force Base
W/S	Warehouse and Service Areas
lb	Pounds

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ACKNOWLEDGMENTS

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1.0 INTRODUCTION

1.1 PROGRAM OBJECTIVES

The United States Air Force (USAF) has sponsored the development of standard ergonomics assessment methodology guides and management tools, which will be integrated into the AFOSH Program. The methodologies and tools are used as a means to minimize or eliminate work-related musculoskeletal disorders (WMSDs) associated with routine exposure to ergonomics risk factors at Air Force installations.

This Level I Ergonomics Methodology Guide Supplement for Warehouse and Service Areas supplements the Level I Ergonomics Methodology Guide for Maintenance and Inspection Work Areas (M/I) and the Guide for Administrative Work Areas. It is designed to be read and implemented by Bioenvironmental Engineers and Bioenvironmental Engineering Technicians. The purpose of the Guide Supplement is to enable the Bioenvironmental Engineering Flight (BEF) to identify risk factors, to prioritize problems, to select realistic controls, and to facilitate modifications to work areas so that the United States Air Force (USAF) can maintain readiness by improving employee performance and well being.

This Guide Supplement contains only the Appendices related to hazard identification and control for warehouse and service area jobs. For instruction in the use of the Level I Ergonomics Methodology Guides, the reader needs to refer to the M/I Guide.

This Guide Supplement enables users to identify risk factors and recommend corrective actions on most of the jobs and tasks they will observe with the assurance that, in most cases, a professional ergonomist would have made the same decisions. It will also let them know when they should obtain assistance from IERA/RSHE or other ergonomists in cases when the pattern-matching process may not adequately address the problem and a Level II Ergonomics Assessment is needed.

This Guide Supplement provides the USAF with the Methodology it needs to identify and abate ergonomics hazards in a wide range of warehouse and service area jobs.

1.2 DEVELOPMENT OF CRITERIA

The Level I Ergonomics Methodology Guide Supplement for Warehouse and Service Areas (hereafter referred to as the W/S Guide Supplement) details a process that can be applied to the full variety of Air Force warehouse and service jobs.

The Guide Supplement was designed to enable a Bioenvironmental Engineer or Technician with two to three years of experience to conduct aggressive task-based problem-solving efforts in an Ergonomics Problem Area (EPRA). The Guide is designed such that the process can be completed as follow-up to the Job Requirement/Physical Demands (JR/PD) Survey completed by Public Health Flight (PHF) or in response to an Air Force occupational illness investigation.

The Guide was developed in accordance with criteria established by the United States Air Force (USAF). This criteria was that the Guide must be designed to enable users, primarily through visual observations and employee/supervisor interviews, to:

- identify potentially hazardous tasks within a shop and a job;
- determine if the content of the job and task(s) meet established ergonomics risk factor exposure criteria;
- determine which type(s) of additional (Level II) analyses may be used if further quantification of ergonomics hazards is required; and
- choose from a menu of control options (both short- and long-term) which when implemented, will minimize the risk of musculoskeletal disorders by reducing the hazards identified within the job and tasks.

The Guide Supplement enables the user to complete data collection and analysis for warehouse and service work areas in 1-2 hours depending on the number of tasks evaluated. Hazard Control selection and development of a summary report of recommendations also requires 1-2 hours. (The End-user test results and experience with the previous Guides indicate that the time requirements are significantly less.)

The Guide Supplement also includes case studies for typical warehouse and service tasks. The case studies serve as the basis for the pattern-matching process that will be used to "match" the hazards identified in the tasks with controls that, when implemented, will reduce employee exposures to ergonomic risk factors and prevent WMSDs.

The Guide Supplement identifies metrics that will be used to judge the impact of ergonomics improvements on employee health, safety, and performance (e.g., quality, and productivity).

In addition, the Guide Supplement incorporates information and lessons learned from the JR/PD Survey in order to provide an integrated ergonomics analysis and problem-solving process for the Air Force.

1.3 DEVELOPMENT PROCESS

The Guide Supplement design is the result of a development and testing process that benefited from the support and cooperation of Air Force personnel at several AFMC locations:

- IERA/RSHE, Brooks AFB, Texas
- Wright-Patterson AFB, Ohio (WPAFB)
- Eglin AFB, Florida
- Tinker AFB, Oklahoma
- Hill AFB, Utah

1.3.1 Initial Efforts. The development of this Guide Supplement began with a review of the scientific literature that had been published related to warehousing and service areas. The purpose of this review was to supplement the ergonomic analysis tools and problem-solving approaches that had been developed for the previous Guides.

Data for the Guides was collected during the actual site visits to Wright-Patterson AFB, Eglin AFB, Tinker AFB, and Hill AFB. Additional site visits were made to Hill AFB and WPAFB in the development of this Guide Supplement. The purpose of the site visits was to collect data (e.g., videotapes, digital photographs, workstation measurements, employee interview results, etc.) on the job types that would be used for developing Case Study Problem-Solving Matrices. The job types were selected by the Air Force and are consistent with "Types of Work" listed in Section III of the JR/PD Survey, which is used by PHF. Many of the jobs observed in the development of the 20 task-based Case Study Problem-Solving Matrices, listed in Table 1.1, are based on a compilation of the most common elements found in one or more jobs at one or more of the bases.

Based on the results of the recent literature review and the site visits, the following components of the Guide Supplement were enhanced or revised:

1. A Level I Ergonomics Assessment Checklist;
2. Checklist Glossary;
3. Corrective Action Scoring List;
4. Case Study Problem Solving Matrices (Corrective Actions); and
5. Minor Modifications and Design Criteria for Major Modifications

These components were used to test the usability of the design of the Guide Supplement.

1.3.2 Usability Testing. Those who are interested in a detailed description of the usability testing process and results should contact IERA/RSHE for further information.

1.4 REFERENCE TO PRIOR GUIDES

For further information, and answers to frequently asked questions, please refer to the M/I Guide Introduction. Specifically, for a general overview of Ergonomics, see Section 2.0; for more detailed information on how to use this Guide Supplement, see Section 3.0 of the Guide.

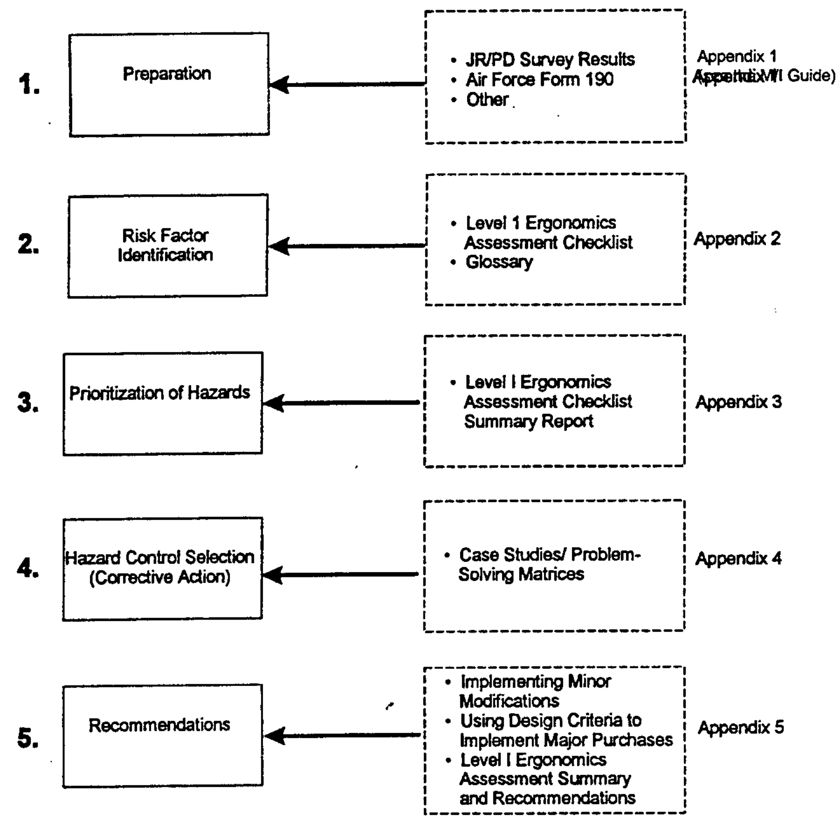
2.0 ORGANIZATION OF THE GUIDE SUPPLEMENT

The Guide Supplement is organized so that the parts needed for data collection can be extracted for use in the field. Other parts used in problem prioritization, solution selection, etc., may be left in the BEF shop for later use.

2.1 OVERVIEW OF THE METHODOLOGY

The first five appendices correspond with Level I Ergonomics Assessment and Problem-Solving Methodology as shown in Figure 1.

Figure 1
Level 1 Assessment Process



2.2 DESCRIPTION OF THE APPENDICES

The appendices provide the tools for implementing this Guide Supplement.

2.2.1 Appendix 1: Preparation

This appendix provides users with a sample summary from the Job Requirements and Physical Demands (JR/PD) Survey, with an Air Force Form 190, and other information that they need to begin the process.

2.2.2 Appendix 2: Risk Factor Identification

This appendix provides users with a sample *Level 1 Ergonomics Assessment Checklist* to use as a guide in completing the checklist they are using on a job. Most importantly, it includes the Glossary, which defines each checklist question in detail and provides guidelines on what to look for when observing the jobs.

2.2.3 Appendix 3: Prioritization of Hazards

This appendix provides users with a sample of a completed *Checklist Scoring Summary* so that they know how to score the jobs on which they have completed a checklist.

2.2.4 Appendix 4: Hazard Control Selection

This appendix is the focal point for identifying the causes of ergonomics risk factors and for selecting corrective actions. *Case Studies* for 20 tasks in warehouse and service areas are included, along with one case study, Lifting, from the M/I Guide. This case study has been expanded to provide information on warehouse tasks. Case Study problem-solving matrices are organized so that users simply look for the body region and risk factor identified in the Level I Checklist in order to pattern-match the cause with corrective actions, risk factor by risk factor. Once users become familiar with the process, this is probably the only appendix that they will need for subsequent assessments. This appendix also includes an example of a completed *Corrective Action List.*

2.2.5 Appendix 5: Recommendations

This appendix provides an example of a completed *Summary/Recommendations* form so that the user has guidance when completing Step 5. A section on "Using Design Criteria to Implement Major Purchases" is included to provide users involved in the selection of equipment and tools, with the ergonomics criteria upon which to evaluate products. The evaluation forms provided can be sent to prospective vendors to help identify which products meet the criteria. It also includes the "Implementing Minor Modifications" section, which provides further detail on selected Corrective Actions referred to in the Case Studies.

2.2.6 Appendix 6: Blank Forms

This section simply provides the blank forms that users can copy in order to apply the Methodology. The forms included are:

Cover Page
Checklist: Part I, Part II, Part III & IV
Ergonomics Scoring Summary
Corrective Action List
Summary and Recommendations

2.2.7 Appendix 7: References/Bibliography

References noted in the Guide and the bibliography for this effort are found in this section.

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APPENDIX 1

Preparation

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APPENDIX 1

This appendix corresponds with Step 1: Preparation. It provides completed examples for:

- a JR/PD Survey;
- a JR/PD Survey Summary Report; and
- an AF Form 190.

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JOB REQUIREMENTS AND PHYSICAL DEMANDS SURVEY

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JRPD SURVEY

A completed JRPD survey form is provided to show the type of information upon which the JRPD Survey Summary Report was compiled. One note of caution: the installation Ergonomics Working Group (EWG) does not make conclusions based on responses on individual surveys. This sample is only intended to provide an understanding of the overall process.

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JOB REQUIREMENTS AND PHYSICAL DEMANDS SURVEY

Job Requirements and Physical Demands Survey	Date (YYMMDD) 980831	**Workplace Identifier:**	NA
(use this space for mechanical imprint)		Base: Kirtland AFB	Organization: DeCA
		Workplace: Commissary - Cashier	
		Bldg. No/Location: 20180	Room/Area:
		AFSC/Job Series: GS-2091-03 Sales Store Cashier	

Gender:	Female ●	Male ○			
Work Group:	Civilian ● Grade: 3	Military ○ Rank: _			
Age Category:	20 and under ○	21-30 ○	31-40 ○	over 40 ●	
Length of service at this base:	less than one year ●	more than one year ○			
Length of time in current shop:	less than one year ●	more than one year ○			
Have you completed this questionnaire before?	Yes ○	No ●			

Part I - Job Factors

This section enables you to describe what is involved in your job. Indicate how long you do this work on approximately a daily basis.

A. DESCRIPTION OF WORK

SHOULDER / NECK

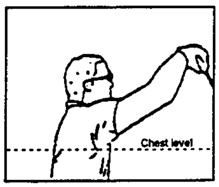


Figure A.

	Never	0-2 hrs.	2-4 hrs.	4-8 hrs.
1. I work with my hands at or above chest level. *(Figure A.)*	○	○	○	●
2. To get to or to do my work, I must lay on my back or side and work with my arms up.	●	○	○	○
3. I must hold or carry materials (or large stacks of files) during the course of my work.	○	○	○	●
4. I force or yank components or work objects in order to complete a task.	●	○	○	○
5. I reach or hold my arms in front of or behind my body (e.g., using a keyboard, filing, handling parts, performing inspection tasks, pushing or pulling carts, etc.). *(Figure B.)*	○	○	○	●
6. My neck is tipped forward or backward when I work. *(Figure C.)*	○	○	○	●
7. I cradle a phone or other device between my neck and shoulder. *(Figure D.)*	●	○	○	○

Figure B.

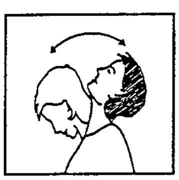


Figure C.

Figure D.

Part I - Job Factors (continued)

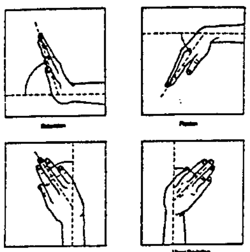


Figure E.

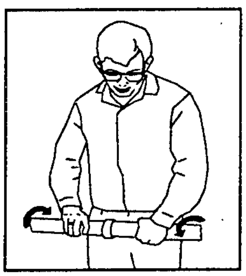


Figure F.

HAND/WRIST/ARM	Never	0-2 hrs.	2-4 hrs.	4-8 hrs.
8. My wrists are bent (up, down, to the thumb or little finger side) while I work. ***(Figure E.)***	○	○	○	●
9. I apply pressure or hold an item/material/tool (e.g., screw driver, spray gun, mouse, etc.) in my hand for longer than 10 seconds at a time.	○	○	○	●
10. My work requires me to use my hands in a way that is similar to wringing out clothes. ***(Figure F.)***	●	○	○	○
11. I perform a series of repetitive tasks or movements during the normal course of my work (e.g., using a keyboard, tightening fasteners, cutting meat, etc.).	○	○	○	●
12. The worksurface (e.g., desk, bench, etc.) or tool(s) that I use presses into my palm(s), wrist(s), or against the sides of my fingers leaving red marks on or beneath the skin.	●	○	○	○
13. I use my hand/palm like a hammer to do certain aspects of my work.	●	○	○	○
14. My hands and fingers are cold when I work.	●	○	○	○
15. I work at a fast pace to keep up with a machine production quota or performance incentive.	○	○	○	●
16. The tool(s) that I use vibrates and/or jerks my hand(s) and arms(s).	●	○	○	○
17. My work requires that I repeatedly throw or toss items.	○	○	○	●
18. My work requires me to twist my forearms, such as turning a screwdriver.	●	○	○	○
19. I wear gloves that are bulky, or reduce my ability to grip.	●	○	○	○
20. I squeeze or pinch work objects with a force similar to that which is required to open a lid on a new jar.	●	○	○	○
21. I grip work objects or tools as if I am gripping tightly onto a pencil.	●	○	○	○

Part I - Job Factors (continued)

BACK/TORSO

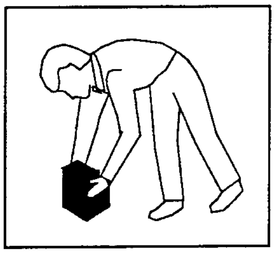


Figure G.

	Never	0-2 hrs.	2-4 hrs.	4-8 hrs.
22. When I lift, move components, or do other aspects of my work, my hands are lower than my knees. *(Figure G.)*	●	○	○	○

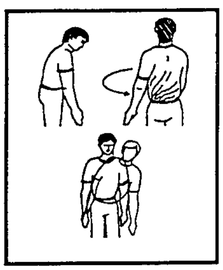


Figure H.

	Never	0-2 hrs.	2-4 hrs.	4-8 hrs.
23. I lean forward continually when I work (e.g., when sitting, when standing, when pushing carts, etc.).	○	○	○	●
24. The personal protective equipment or clothing that I wear limits or restricts my movement.	●	○	○	○
25. I repeatedly bend my back (e.g., forward, backward, to the side, or twist) in the course of my work.	○	○	○	●
26. When I lift, my body is twisted and/or I lift quickly. *(Figure H.)*	○	○	○	●

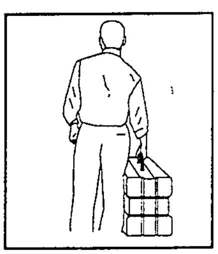


Figure I.

	Never	0-2 hrs.	2-4 hrs.	4-8 hrs.
27. I can feel vibration through the surface that I stand on or through my seat.	○	○	○	●
28. I lift and/or carry items with one hand. *(Figure I.)*	○	○	○	●
29. I lift or handle bulky items.	○	●	○	○
30. I lift materials that weigh more than 25 pounds.	○	●	○	○

Part I - Job Factors (continued)

LEGS / FEET

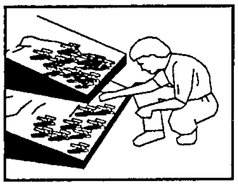


Figure J.

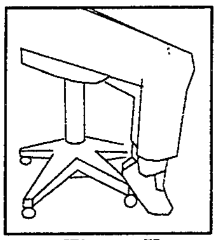


Figure K

	Never	0-2 hrs.	2-4 hrs.	4-8 hrs.
31. My work requires that I kneel or squat. *(Figure J.)*	○	●	○	○
32. I must constantly move or apply pressure with one or both feet (e.g., using foot pedals, driving, etc.).	●	○	○	○
33. When I'm sitting, I cannot rest both feet flat on the floor. *(Figure K.)*	●	○	○	○
34. I stand on hard surfaces.	○	○	○	●

HEAD / EYES

	Never	0-2 hrs.	2-4 hrs.	4-8 hrs.
35. I can see glare on my computer screen or worksurface.	○	○	○	●
36. It is difficult to hear a person on the phone or to concentrate because of other activity, voices, or noise in/near my work area	○	○	○	●
37. I must look at the monitor screen constantly so that I do not miss important information (radar scope).	○	○	○	●
38. It is difficult to see what I am working with (monitor, paper, parts, etc.).	●	○	○	○

Part I - Job Factors (continued)

B. ORGANIZATIONAL FACTORS

	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
39. I often feel unclear on what the scope and responsibilities of my job are.	○	○	●	○	○
40. I often feel that I have too heavy of a workload, one that I could not possibly finish during an ordinary workday.	●	○	○	○	○
41. I often feel that I will not be able to satisfy the conflicting demands of various people around me.	○	○	○	○	●
42. I often find myself unable to get information needed to carry out my job.	○	○	●	○	○
43. I often do not know what my supervisor thinks of me, how he/she evaluates my performance.	○	○	○	●	○
44. I often think that the amount of work I have to do interferes with how well it's done.	○	●	○	○	○

C. PHYSICAL EFFORT

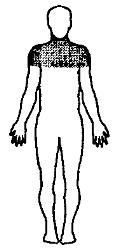
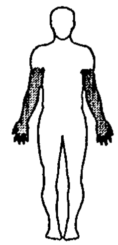
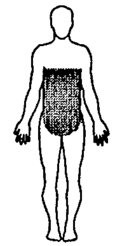
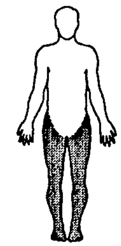
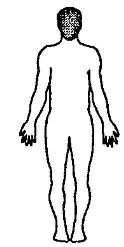
45. How would you describe the physical effort required of your job?

6 No exertion at all	7 Extremely light	8	9 Very light	10	11 Light	12	13 Somewhat hard	14	15 Hard	16	17 Very hard	18	19 Extremely hard	20 Maximal exertion
○	○	○	○	○	○	○	●	○	○	○	○	○	○	○

Part II - Your Body's Response to Work Demands

D. DISCOMFORT FACTORS

This section enables you to identify how your body responds to the demands of ***your job***. In each section, answer the first question. If the answer is "no" go to the next column.

					
Question	**Shoulder/Neck**	**Hands/Wrists/Arms**	**Back/Torso**	**Legs/Feet**	**Head/Eyes**
• In the past 12 months, have you experienced any discomfort, fatigue, numbness, or pain that ***relates to your job***?	46. Yes ● No ○ *If "no", go to question 49*	49. Yes ● No ○ *If "no", go to question 52*	52. Yes ● No ○ *If "no", go to question 55*	55. Yes ● No ○ *If "no", go to question 58*	58. Yes ● No ○ *If "no", go to question 61*
• How often do you experience discomfort, fatigue, numbness, or pain in this region of the body?	47. Daily ● Weekly ○ Monthly ○	50. Daily ● Weekly ○ Monthly ○	53. Daily ○ Weekly ● Monthly ○	56. Daily ○ Weekly ● Monthly ○	59. Daily ○ Weekly ○ Monthly ●
• On average, how severe is the discomfort, fatigue, numbness, or pain in this region of the body?	48. Mild ● Moderate ○ Severe ○	51. Mild ● Moderate ○ Severe ○	54. Mild ● Moderate ○ Severe ○	57. Mild ● Moderate ○ Severe ○	60. Mild ● Moderate ○ Severe ○

Part II - Your Body's Response to Work Demands (continued)

E. GENERAL QUESTIONS

61. In the past 12 months, have you seen a health care provider for any pain or discomfort that you think **relates to your job?** Yes ○ No ●

62. Do you experience any work-related pain or discomfort that does not improve when you are away from work overnight or over the weekend? Yes ○ No ●

63. In the past 12 months, has any work-related pain or discomfort caused you difficulty in carrying out normal activities (e.g., job, hobby, leisure, etc.)? Yes ○ No ●

64. Has a health care provider ever told you that you have any of the following conditions which you think might be **related to your work?** Yes ○ No ●

- Tendonitis/Tenosynovitis
- Epicondylitis (Tennis Elbow)
- Thoracic Outlet Syndrome
- Ganglion Cyst
- Bursitis
- Back Strain
- Trigger Finger
- Carpal Tunnel Syndrome
- Knee or Ankle Strain
- Overuse Syndrome

65. Do you have or have you ever had one or more of the following conditions? Yes ○ No ●

- Wrist Fracture
- Thyroid Disorder
- Rheumatoid Arthritis
- Hypertension
- Diabetes
- Kidney Disorders
- Gout

Part III - Work Content

The section below will enable you to describe the content of the work that you do in your current shop.

Fill in the box that describes how frequently you do the task listed, based on the following definitions:

- **Routine:** Performed on three or more days per week.
- **Non-routine:** Performed two days a week or less.
- **Seasonal:** Performed only during certain times of the year
- **Never/NA:** You do not perform this type of work.

No.	Type of Work	Work Frequency (Check one)			
		Routine	Non-Routine	Seasonal	Never/NA
66.	abrading	○	○	○	●
67.	baking	○	○	○	●
68.	bolting/screwing	○	○	○	●
69.	calling (telephone use)	●	○	○	○
70.	chipping	○	○	○	●
71.	cleaning by hand	○	○	○	●
72.	cleaning with high pressure equipment	○	○	○	●
73.	coating/immersing	○	○	○	●
74.	cooking	○	○	○	●
75.	copying	○	○	○	●
76.	crimping	○	○	○	●
77.	cutting/shearing	○	○	○	●
78.	drafting/CAD system use	○	○	○	●
79.	drilling	○	○	○	●
80.	driving (vehicles)	○	○	○	●
81.	excavating	○	○	○	●
82.	filing/general administrative	○	○	○	●
83.	flame cutting/arc cutting	○	○	○	●
84.	folding/fitting	○	○	○	●
85.	gluing/laminating	○	○	○	●
86.	grinding/buffing/polishing	○	○	○	●
87.	hammering	○	○	○	●
88.	lifting	●	○	○	○
89.	loading (pallets, trucks, carts, aircraft)	○	○	○	●
90.	lubricating	○	○	○	●

Part III - Work Content (Continued)

No.	Type of Work	Routine	Non-Routine	Seasonal	Never/NA
		Work Frequency (Check one)			
91.	machining	○	○	○	●
92.	masoning	○	○	○	●
93.	melting	○	○	○	●
94.	molding	○	○	○	●
95.	monitoring (visual displays)	○	○	○	●
96.	mousing (for computer work)	○	○	○	●
97.	nailing	○	○	○	●
98.	opening/closing heavy doors	○	○	○	●
99.	packing/packaging	○	○	○	●
100.	painting/spray painting	○	○	○	●
101.	paving	○	○	○	●
102.	pumping (by hand)	○	○	○	●
103.	riveting/bucking	○	○	○	●
104.	sanding	○	○	○	●
105.	sawing	○	○	○	●
106.	scanning (using bar code readers)	●	○	○	○
107.	sewing	○	○	○	●
108.	soldering/brazing	○	○	○	●
109.	stapling	○	○	○	●
110.	stripping/depainting by hand	○	○	○	●
111.	stripping/depainting mechanically	○	○	○	●
112.	transporting loads on non-powered carts	○	○	○	●
113.	turning valves	○	○	○	●
114.	tying/twisting/wrapping	●	○	○	○
115.	typing/keying	●	○	○	○
116.	welding	○	○	○	●
117.	wheeling loads	○	○	○	●
118.	wiring	○	○	○	●
119.	wrenching/ratcheting	○	○	○	●
120.	writing/illustrating	○	○	○	●
	(Write in others)				
121.	____________________	○	○	○	○
122.	____________________	○	○	○	○

Part IV - Process Improvement Opportunities

Think about your job as a whole, including routine, non-routine or seasonal work.

Read the questions listed below and **describe the activities** that you or your co-workers think place the greatest demands on your body.

1. Which tasks are the most awkward or require you to work in the most uncomfortable positions?
Scanning a 20-40lbs bag of dog food.
Standing all day.

2. Which tasks take the most effort?
Standing all day.

3. Are there any tools or pieces of equipment that are notoriously hard to work with? (If so, list them below)
Certain conveyor belt makes a lot of noise. which causes an earache or
Headache by the end of the day.

4. If you could make any suggestions that would help you do your job more easily or faster or better, what would you suggest?
Gun scanner for heavy merchandise.
Bar stool for each register. to minimize prolonged standing.
Conveyor belt should be routinely checked for noise level.

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JRPD Survey Summary Report

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JRPD Survey Summary Report

You will need to refer to this report when you are conducting pro-active problem-solving in EPRA-designated shops. Table A describes parts of the report that may be particularly helpful.

Table A
JRPD Survey Summary Report - Items to Include in Pre-Shop Visit Review

Where	Selected Items/Information	What it Tells You
Page 1	Steps 1, 2, and 3. Items A.1-A.5 and D.1-D.5 are combined using the Ranking Matrix to generate the Priority Rank for the shop. The highest score for any body region (e.g., shoulder/neck, back/torso, etc.) is used as the Priority Rank on which the EWG makes its initial judgment about EPRA status.	Look at the highest body part ratings for the shop as a whole. If the shoulder/neck, for example, gets the highest ratings, you may wish to pay special attention to risk factors/demands on the shoulder as you perform assessments in the shop. Also, if your Level I Checklist results generate a high relative score for the same region, you might conclude that the job/task that is the focus of your assessment, may be contributing to reported shoulder/neck problems throughout the shop.
Page 2	Steps 4 and 5. The Organizational Rating indicates the perceived level of "job stress" in the shop. The Physical Effect Factors score indicates people's overall perception of physical demands (e.g., easy, hard, etc.)	A "high" Organizational Rating could indicate that high levels of job stress (e.g., poor relationship with supervisor, high work load, etc.) throughout the shop may be increasing people's experience with pain and discomfort. While you are not necessarily responsible for dealing with job stress, employees may comment about it during the course of your assessment. A Physical Effect Factors score of 15 or higher indicates that employee's think the over job demands in the shop are "high" (15 = hard on the survey). You should be sensitive to this as you are performing the assessment.

Table A (Cont'd)
JRPD Survey Summary Report - Items to Include in Pre-Shop Visit Review

Where	Selected Items/Information	What it Tells You
Page 2	Step 6. Health Care Provider Score. Activity Interruption Percentage.	Health Care Provider Score indicates number of employees who have received prior medical attention for a disorder. Activity Interruption Percentage indicates the percentage of employees whose work or home activities have been affected by work-related pain or discomfort.
Page 2	Step 7. List of routine types of work.	This information is particularly important. This is the list of tasks that you will verify with the shop supervisor and from which you may select jobs to include in your proactive assessment.
Page 3	Step 8. Information on "potential concerns" and "improvement opportunities" within the shop.	Information in Step 8 may help you fine tune or prioritize the list of jobs you wish to include in your assessment. Pay close attention to the improvement opportunity remarks. Employees are providing you with some time-saving insight into what may help reduce ergonomics risk factors or pain/discomfort throughout the shop.

JOB REQUIREMENTS AND PHYSICAL DEMANDS SURVEY SUMMARY REPORT

ERPA Status:	EPRA	Priority Ranking:	5	Date:	2 Sep 98

Date: 2 September 1998	Workplace Identifier: 0097-BACO-1606A	Base: Kirtland AFB
Organization: DeCA/MW-KIR	Workplace: Cashiers/Front End	Bldg./Location: 20180
Room/Area NA	AFSC:	Civilian Job Series: GS-2091
Shop Supervisor: Jeanette Craig	Duty Phone: 6-9586	Office Symbol: XOC

Step 1	Step 2	Step 3	
Write in the **Risk Factor Rating** for Part I, (questions 1-38, Scoring Sheet pg.1)	Write in the **Discomfort Rating** for Part II, (questions 46-60, Scoring Sheet pg.3)	Look at the "Ranking Matrix" below and enter the **Priority Score** in it's corresponding box.	
A.1 Medium	D.1 Medium	**Shoulder/Neck =**	5
A.2 Medium	D.2 Medium	**Hands/Wrist/Arms =**	5
A.3 Medium	D.3 Low	**Back/Torso =**	2
A.4 Low	D.4 Low	**Legs/Feet =**	1
A.5 Medium	D.5 Low	**Head/Eye =**	2

Ranking Matrix	Ranking Matrix for **Priority Score**	Discomfort High	Discomfort Medium	Discomfort Low
	Risk Factor High	9	7	4
	Risk Factor Medium	8	5	2
	Risk Factor Low	6	3	1

Select the HIGHEST score for any body part from Step 3 and enter →

Survey Priority Rank: 5

JOB REQUIREMENTS AND PHYSICAL DEMANDS SURVEY SUMMARY REPORT

Step 4

B. Enter **Organizational Rating:** (Questions 39-44, Scoring Sheet pg. 2) 10	**Comments:** None

Step 5

C. Enter **Physical Effect Factor Score:** (Question 45, Scoring Sheet pg.2) 12	**Comments:** None

Step 6

E. Enter the score for each of the **General Questions:** (Questions 61-65, Scoring Sheet pg. 4)

E.1 Health Care Provider Score 2 %	**Comments:**
E.2 Recovery Time Score 20 %	**Comments:**
E.3 Activity Interruption Score 7 %	**Comments:**
E.4 Previous Diagnosis Score 13 %	**Comments:**
E.5 Contributing Factors Score 13 %	**Comments:**

Step 7

F. List below each of the routine types of work which had shop percentage scores over 20%. (Items 66-122, scoring sheet page 5)

Type of Work	%	Type of Work	%
Calling (telephone use)	40		
Lifting	73		
Monitoring Visual Display	33		
Scanning (use bar-code reader)	80		
Typing/Keying	53		

JOB REQUIREMENTS AND PHYSICAL DEMANDS SURVEY SUMMARY REPORT

Step 8	
Review Part IV (Questions 1-3) to identify tasks, tools, equipment, etc., that employees listed as potential concerns. Comment as appropriate.	**Comments:** Standing all day is hand on the body. Large bags of pet food and water jugs are difficult to lift in order to scan. Cash drawer is too low and work area is confined.
Review Part IV (Question 4) to identify potential improvement opportunities. Comment as appropriate.	**Comments:** Gun scanner for heavy merchandise so one doesn't have to lift items to the conveyor. A stool for each register or something to minimize prolonged standing.
Step 9	
Injury/Illness Data: Review the injury/illness history from this shop. Attach information and comment as appropriate.	**Comments:**

Step 10
Conclusions / Recommendations Summary

Shop Status	Recommendations for follow-up:
EPRA	Level I Assessment

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AF Form 190

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AF Form 190

Attached is a completed AF Form 190. Table B describes parts of the report that may be particularly helpful.

Table B
AF Form 190 - Items to Include in Pre-Shop Visit Review

Selected Items/Information	What it Tells You
Items 6 and 10. Work Location and Occupation (Job Title/AFSC)	This information may help you pin point the possible job or workstation source of reported potential ergonomics problems.
Item 25. Describe Job Tasks that Resulted in Exposure to Hazardous Materials/Agents (Specify the material/agent).	The more specific the information, the more helpful it will be to prepare for your assessment. Ideally, the description will provide, not only information on the physical movements that may be the source of stress (e.g., radial, ulnar deviation), but information on a specific job or series of tasks in which those movements occur. It is the task-specific information which will help you decide where to begin the Level I Assessment.
Item 12. Diagnosis and Relevant Medical Data.	This description will help you focus your assessment. In other words, while you will be completing the Level I Ergonomics Assessment Checklist in order to assess exposure for all of the body regions, knowing in advance that the person is suffering from a lateral epicondylitis (elbow) may make you more sensitive to risk factors for that body region.
Step 31. Bioenvironmental Survey.	One of the primary purposes of the Level I Ergonomics Assessment and Problem-Solving Guide for Warehouse, Materials Handling, and Assembly Work Areas is to provide you with the tools to supplement your own ergonomics expertise and enable you to complete this section.

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95-457

OCCUPATIONAL ILLNESS / INJURY REPORT

(THIS FORM IS SUBJE… TO THE PRIVACY ACT OF 1974 - Use Blanket F… DD Form 2005)

PATIENT IDENTIFICATION

I.

1. NAME (Last, First, MI)	2. SSAN	3. GRADE	4. SEX	5. AGE
[redacted] 95-222	[redacted]	☐ MIL ☒ CIV	☒ M ☐ F	35

6. …K LOCATION	7. DUTY PHONE	8. ORGANIZATION AND SYMBOL	9. INSTALLATION
B 2121/FLAP SHOP	63860	OC-ALC/LIPPBS	TINKER AFB, OK 73145

10. OCCUPATION (Job Title/AFSC)	11. SUPERVISOR (Name and Duty Phone)
A/C SHEETMENTAL MECHANIC/3806/WG-10	[redacted]

INCIDENT / ILLNESS DATA

II.

12. …E AND TIME OF	13. STATUS AT TIME OF EXPOSURE
…OSURE: SINCE 1988 ILLNESS: FEB 95	☒ ON DUTY ☐ OFF DUTY ☐ LEAVE ☐ TDY ☐ OTHER

14. DURATION OF EXPOSURE	15. WITNESS (Name and Phone)
7 YEARS, 6 MONTHS, 25 DAYS (≈ 91 mo)	NONE

16. DESCRIPTION OF SYMPTOMS AT ONSET OF ILLNESS

"This has happened in Bldg. 2121. My job calls for the use of alot of power tools such as drill motors, rivet guns, etc. I do alot of overhead and below knee work. My right elbow has started hurting me and has progressively gotten worse."

MEDICAL DATA

III.

17. DIAGNOSIS AND RELEVANT MEDICAL DATA (Indicate affected body parts)

RIGHT LATERAL EPICONDYLITIS

ICD9 - 726.32

18. CLASSIFICATION [2]

		OSHA CODE
	OCCUPATIONAL SKIN DISEASE	21
	DUST DISEASE OF LUNGS	22
	RESPIRATORY CONDITION DUE TO TOXIC AGENT	23
	SYSTEMATIC EFFECT OF TOXIC MATERIAL (poisoning)	24
	DISORDER DUE TO PHYSICAL AGENT (Other than toxic material)	25
X	DISORDER DUE TO REPEATED TRAUMA (Exclude hearing loss)	26
	OTHER OCCUPATIONAL DISEASE	29

☐ FATALITY ☐ RESULTED IN UNCONSCIOUSNESS

19. DATE/TIME OF INITIAL TREATMENT/DIAGNOSIS: …JLY 95/1422-1545

20. MEDICAL FACILITY: 72D AMDS/SGPFO, OMS, BLDG. 3001

21. TREATMENT ADMINISTERED (Check One) ☒ FIRST AID [1] ☐ DEFINITIVE CARE (Specify In Remarks)

DISPOSITION OF PATIENTS

22.

YES	NO		NO. OF DAYS	
	X	RETURN TO NORMAL DUTY	0	ADMITTED TO HOSPITAL
	X	REFER TO PRIVATE PHYSICIAN	0	PLACED [redacted]
	X	EXCUSED FOR REST OF DUTY DAY	7	RETURN TO [redacted]

23. NAME OF MEDICAL OFFICER [redacted] MAJ, USAF, MC, FS, 044F3

MAJOR
MEDICAL CORP
AFSC: 044F3
72 MG, TINKER AFB OK 73145-3065

24. REMARKS

DEFINITIVE CARE NOT SPECIFIED BY THE ATTENDING PHYISICIAN.

ENVIRONMENTAL DATA

IV.

25. DESCRIBE JOB TASKS THAT RESULTED IN EXPOSURE TO HAZARDOUS MATERIALS / AGENTS (Specify the material / agent)

Mr[redacted]s duties is primarily a standing operations with most parts positioned on work tables or fixtures of various fixed heights in either the Back or flap shop. He corrects defects and sheet metal "skins" and frames by using a variety of handheld tools. Operations include: removing rivets with drills, using cleco pliers to install clecos to hold parts, countersinking bolt holes with a drill, shooting rivets while using various guns (e.g. rivet and cherry loc) and while holding various sizes of bucking bars, microshaving rivets, cutting sheet metal with manual or pneumatic shears, sanding and bufing various edges, wiring some fastners with safety wire pliers, using hammers, mallets and files, painting and cleaning parts, installing brakcets using am impact wrench

V. … CASE CLASSIFICATION …

26. OCCUPATIONAL INCIDENT	27. TYPE	28. WORKPLACE IDENTIFIER
☒ YES ☐ NO	☐ INJURY ☒ ILLNESS	0 1 8 8 DADO 2 0 6

29. REVIEWING OFFICER [redacted] MD, CHIEF OMS, 09356C

30. DATE (YYMMDD) 951018

1. One-time treatment of minor scratches, cuts, burns, and splinters which do not require professional care.
2. See AFR 127-12.

AF FORM 190, OCT 81 (EF-V1) (PerFORM PRO) PREVIOUS EDITION IS OBSOLETE.

31. BIOENVIRONMENTAL ENGINEERING SURVEY *(Summarize investigation of patient's exposure. Indicate results of appropriate measurements and assessment of protective measures. Consultant reports of or in lieu of this survey should be referenced and attached.)*

Erogmonic stresses include, vibration transmitted to the arms and hands from shooting rivets with various guns and holding bucking bars (this is a high level of exposure, the high level implies that employees use vibrating tools more than four hours distributed over the entire day, or more than 30 minuts continuously or repetitively), forceful exertions are required due to: (1) holding heavy to (i.e., cherry loc gun weighs 10 pounds), (2) using unbalanced tools (i.e., like some of the rivet and impact guns), (3) using manu shears, and (4) working with hard metal. Static work posture is required to use tools with one-finger triggers, localized contact stress to the palm of the hand due to holding bucking bar no designed handle/grip, repetitive wrist deviation are to insert and remove clecos using cleco pliers, repeated wrist extensions and flexion is present when using riveting gun. (this can lead to carpal tunnel syndrome), awkward postures (i.e., forward forearm rotations, elevated shoulders) due to work surfaces and fixtures with fixed heights and to improper match between work surfaces and grip of hand tool, repeated manipulations, deviations and twisting of the wrist while using tools (e.g., hammers, pliers, mallets (this can lead to ganglion cysts, tendonitis or epicondylitis), forced exertions are necessary to lift, pull and push heavy aircraft parts, wrists are flexed due to incorrect height of keyboard. These stresses have been related to ergonomic type conditions.

Consult with Bioenvironmental Engineering concluded that no further information could be provided that could assist in determining the occupational relationship of this condition. Bioenvironmental Engineering has identified these ergonomic stresses, made appropriate recommendations for corrective action and is tracking the recommendations for implemtation.

AFMC FORM 12 RECEIVED: 27 JUL 95
AF FORM 190 SENT TO SGPFO: 31 Jul 95
AF FORM 190 RECEIVED FROM SGPFO: 95/08/08
FINAL DATA ENTRY: 95/08/08

returned from OMS for Signature of block 31, 2 Aug 95
Sent back to OMS 3 Aug 95

[redacted]

32. DATE	33. SURVEY PERFORMED BY
95 | 07 | 28	[redacted] SSgt. USAF. NCOIC, Occupational Health, Public Health Flight

AF FORM 190, OCT 81 *(REVERSE) (EF-V1) (PerFORM PRO)*

APPENDIX 2

Risk Factor Identification

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APPENDIX 2

This Appendix corresponds with Step 2: Risk Factor Identification, and includes:

- The Level I Ergonomics Assessment Checklist Glossary; and
- A sample of a completed Level I Ergonomics Assessment Checklist

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LEVEL I ERGONOMICS
ASSESSMENT CHECKLIST GLOSSARY

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This Glossary provides additional information on each question in the Checklist. For each Job Factor question, the glossary provides:

- An explanation of the ergonomics risk factors upon which the Job Factor question is based;
- An explanation of how exposure to the Job Factor impacts the person;
- Assistance in determining if the Job Factor is present and if it is present at the level specified in the question; and,
- Examples and hints of what to look for in the workplace.

Note: As you gain experience using the Level I Ergonomics Assessment Checklist and with ergonomics in general, your reliance on this Glossary should decrease significantly.

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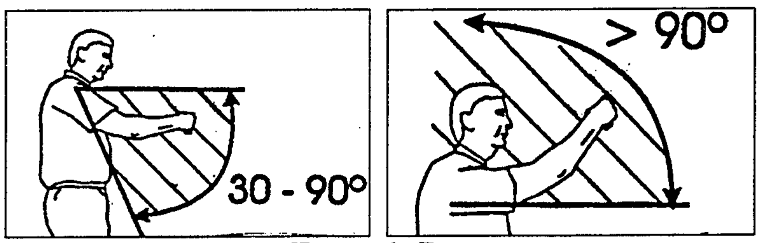
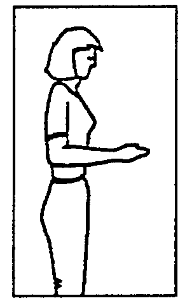
Table 1
Checklist Question 1

Question: **Reaching:** Repeated reaching or arms held continuously away from body while unsupported



Factor is Present


Factor not Present

Targeted Risk Factor Table

	Risk Factor		Risk Factor
x	Stressful Positions or Movements	x	Static (fixed position) work
	Heavy of forceful work	x	High Frequency (repetitive) or high speed movements

Background Discussion

Highly repetitive reaching over a period of time can result in excessive wear of the shoulder joint, rotator cuff tendons, and bursae. Holding the arms away from the body continuously (without support) causes static muscular effort. Static muscular effort produces discomfort in a matter of seconds because the energy stored in the muscle is rapidly depleted and the constricted muscles restrict the flow of replenishment energy and oxygen to the muscle.

What to Look For

This Job Factor is scored when one or both arms is held away from the body or reaches repeatedly away from the body. The shoulder posture is measured from the shoulder joint referencing the upper arm posture with respect to a vertical reference passing through the upper body.

- The *below shoulder level* Job Factor is scored when the upper arm is observed to be approximately 30-90° away from the torso while the task is being performed.

- The *above shoulder level* Job Factor is scored when the upper arm is observed to be greater than 90° away from the torso during while the task is being performed.

Table 1
Checklist Question 1 (cont'd)

This assumes that the torso is upright and in a vertical orientation. If the arms are hanging down while bending, this does not count as reaching unless the person reaches past the shoulders. If the person reaches past the shoulders while bending, this is scored as an *above shoulder level* reach.

As a general rule, reaching would be considered to be "repeated" if the person reaches, on average, every 30 seconds or more frequently. If the holding position is maintained for at least 10 seconds at a time, it would be considered as holding the arms away from the body "continuously".

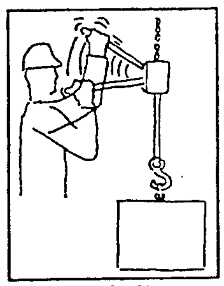
Examples of tasks in which reaching would be scored include:

- Placing or retrieving objects that are too high;
- Placing or retrieving objects in restricted spaces; or,
- Accessing work objects which are far from the body.

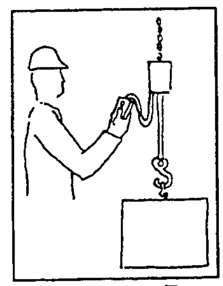
References: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Table 2
Checklist Question 2

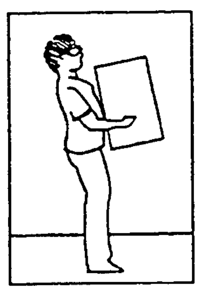
Question: **Arm forces: Repeated arm forces** exceeding 10 lb. (4.5 kg) (e.g. roughly equivalent to lifting a gallon of milk) or **holding/carrying materials** exceeding 25 lb. (11.3 kg) for more than three steps



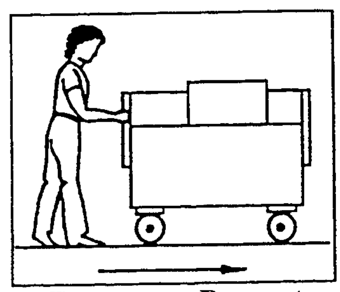
Factor is Present



Factor not Present



Factor is Present



Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Stressful Positions or Movements	x	Static (fixed position) work
x	Heavy or forceful work		High frequency (repetitive) or high speed movements

Background Discussion

Forceful use of the arm, repeatedly, over a period of time can result in wear of the shoulder joint, rotator cuff tendons, and bursae.

Holding and carrying heavy materials for long periods of time can also wear the shoulder joint and create fatigue from static muscular effort.

What to Look For

The *repeated arm forces* portion of the Job Factor is scored if the arm force required to perform the task exceeds 10 lb. (4.5 kg) and the forces occur (on average) at least every

Table 2
Checklist Question 2 (cont'd)

30 seconds. Lifting a gallon of water or milk is about 8 lb. (3.6 kg) So if the task seems to exceed the force required to lift a gallon of liquid, the Job Factor is present.

Examples of tasks in which repeated arm forces would be scored include:

- Driving a fork truck without power assisted steering; or,
- Handling full trays of dishes.

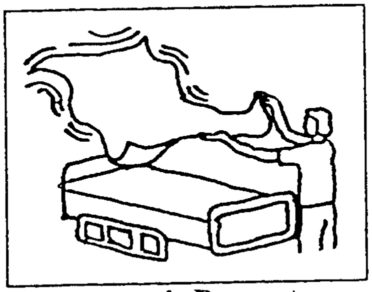
The *holding/carrying materials* portion of the Job Factor is scored if the person carries items which weigh more than 25 lb. (11.3 kg) for more than three steps at a time. This means that in order for the Job Factor to be scored, the item must be carried more than three steps (about 10 feet (3 meters).

Examples of tasks in which holding/carrying materials would be scored include carrying boxes or objects that weigh more than 25 lb. (11.4 kg) for more than a few steps.

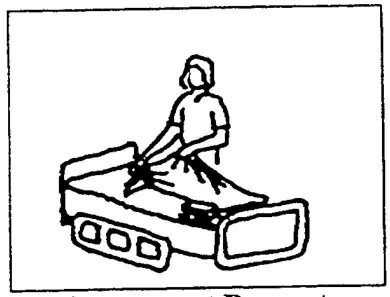
References: 9, 10, 11, 12, 13, 14,15, 16

Table 3
Checklist Question 3

Question: **High speed, sudden shoulder movements** (e.g., opening a stuck door, pulling and yanking on a bed linens to remove them)



Factor is Present



Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
x	Stressful Positions or Movements		Static (fixed position) work
x	Heavy or forceful work	x	High frequency (repetitive) or high speed movements

Background Discussion

High-speed sudden shoulder movements generate very high forces internally in the shoulder joint. These movements can result in wear and excessive damage to the shoulder joint, rotator cuff tendons, and bursae.

What to Look For

This Job Factor is scored when the arms are observed to be moving with high velocity during the task, such as sudden or jerky movements. High speed, sudden shoulder movements typically occur in tasks where high forces are also required.

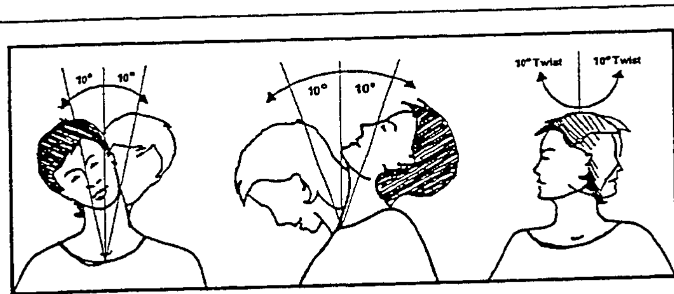
Examples of high speed or sudden shoulder movements may include:

- Any kind of heavy hammering activity (however, using a small hammer to tap might not constitute high speed, sudden shoulder movements);
- Yanking on a stuck object to move it;
- Opening a stuck door;
- Taping boxes
- Throwing objects.

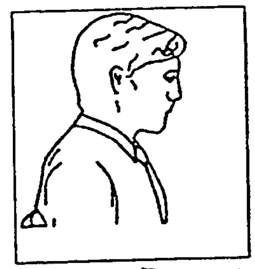
References: 17, 18

Table 4
Checklist Question 4

Question:	**Head/neck bent, tilted, or twisted** (>10°) (e.g., scale display too high or too far away from scale.)



Factor is Present



Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
x	Stressful Positions or Movements	x	Static (fixed position) work
	Heavy or forceful work		High frequency (repetitive) or high speed movements

Background Discussion

Generally, the concern with the head and neck is associated with prolonged use of awkward postures. Maintaining these postures causes static muscular effort since muscles are held in a state of contraction in order to support the head. Static muscular effort produces discomfort in a matter of seconds because the energy stored in the muscle is rapidly depleted and the constricted muscles restrict the flow of replenishment energy and oxygen to the muscle.

What to Look For

This Job Factor is scored when the head is observed to be bent or tilted greater than 10° in any direction (see picture labeled "Factor is present"). The head angle is estimated by observing the orientation of the head with respect to the axis of the torso. Continuous or repetitive twisting of the neck greater than 10° to the left or right is scored as well. The correct posture (see picture labeled "Factor not present") occurs when the head angle is approximately 0° (or less than 10° bending).

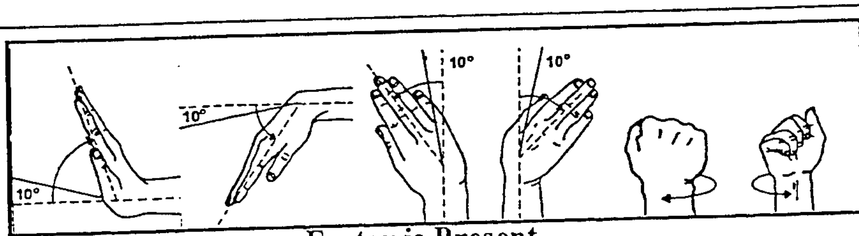
As a rule of thumb, bending of the head/neck would be considered *continuously* if the posture is maintained for at least 10 seconds at a time. Bending of the head/neck would be considered *repeated* if the person bends the head, on average, every 30 seconds or more frequently.

Table 4
Checklist Question 4 (cont'd)

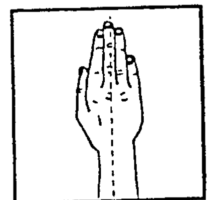
Examples of head/neck bent, tilted, or twisted would include: • Viewing overhead objects or displays; and • Performing detailed inspections or reading in poor lighting conditions (e.g., leaning forward). **References:** 1, 2, 9, 19, 20, 21, 22, 23

Table 5
Checklist Question 5

Question:	**Bent wrists/repeated wrist movements** (>10° in any direction) or **repeated forearm rotation** (e.g., scanning groceries, washing dishes)



Factor is Present


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
x	Stressful Positions or Movements		Exposure to Hard Edges
	Excessive Forces or Forceful Exertions		Exposure to Vibration
x	High frequency (repetitive) or high speed movements		Temperature Extremes (especially cold)
x	Static (fixed position) work		

Background Discussion

Bending the wrist may significantly increase pressure inside the carpal tunnel. Increased pressure on tendons and nerves over time can lead to an accumulation of damage which can lead to tendonitis (i.e., inflammation of tendons) or carpal tunnel syndrome (i.e., compression of the median nerve). Awkward wrist postures also reduce grip strength.

Repeated rotation of the forearms over a period of time can contribute to epicondylitis which is an inflammation of tendons that attach at the elbow joint.

What to Look For

This Job Factor is scored when the wrist is bent greater than 10° in any direction. (see picture labeled "Factor is present").

The wrist angle can be estimated by comparing two reference lines to each other. The first reference line, representing the wrist posture, is created by the point at the center of the knuckles and the point at the center of the wrist. The second reference line, representing the forearm, is created by the point at the center of the wrist and the point at the center of the elbow. A straight wrist (see picture labeled "Factor not present") has an angle of approximately 0° (or bending less than 10°).

Table 5
Checklist Question 5 (cont'd)

Caution: The neutral (resting) posture of the hand and wrist may appear to be tilted back approximately 10°.

Continuous or repetitive rotation of the forearms of greater than 10° inward or outward is scored as well.

As a general rule, bending of the wrist would be considered to be *repeated* if the person bends the wrist, on average, once every 30 seconds or more frequently.

Examples of bent wrists/repeated wrist movements include:

- Using a pistol-shaped scanner on a horizontal surface;
- Scanning groceries;
- Chopping food.

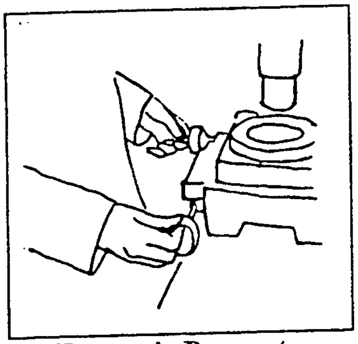
Examples of repeated forearm rotation would include:

- Turning the wrist while scanning groceries;
- Twisting bags closed; and,
- Tossing pieces of meat from the meat cutting saw.

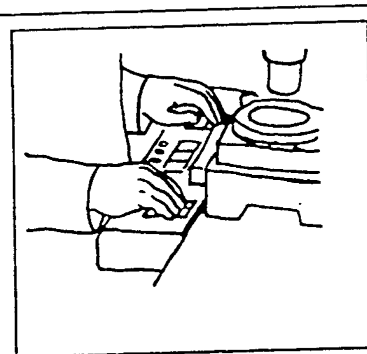
References: 4, 9, 22, 24, 25, 26, 27, 28,

Table 6
Checklist Question 6

Question: **Repeated manipulations with fingers** (e.g., repetitive keying tasks, operating buttons on hand-held scanners)



Factor is Present



Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Stressful Positions or Movements		Exposure to Hard Edges
	Excessive Forces or Forceful Exertions		Exposure to Vibration
x	High frequency (repetitive) or high speed movements		Temperature Extremes (especially cold)
	Static (fixed position) work		

Background Discussion

Highly repetitive finger movements over a period of time can increase stress on the tendons which control finger movement.

What to Look For

This Job Factor is scored when there is significant finger movement observed in a task. Typically, there is a pattern of finger movements that are repeated frequently. As a general rule, if there is a finger movement which repeats at least once every four seconds, then this Job Factor is scored.

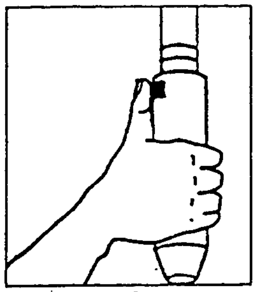
Examples of repeated finger movements would include:

- Repetitive keying tasks;
- Repetitive handling of small components;
- Sorting silverware; and ,
- Picking or counting small objects.

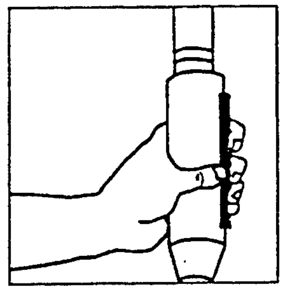
References: 27, 28

Table 7
Checklist Question 7

Question:	**Hyperextension of finger/thumb** (e.g., using cutters with a wide handle span) or **repeated single finger activation** (e.g., single finger triggers on power tools)



Factor is Present



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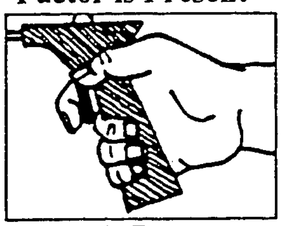

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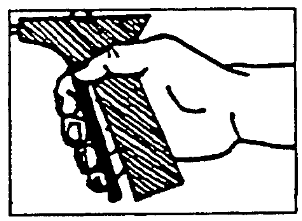


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
x	Stressful Positions or Movements		Exposure to Hard Edges
	Excessive Forces or Forceful Exertions		Exposure to Vibration
x	High frequency (repetitive) or high speed movements		Temperature Extremes (especially cold)
	Static (fixed position) work		

Background Discussion

Hyperextension of finger/thumb and repeated single finger activation may increase the stress on the tendons and muscles controlling those fingers. In hyperextended positions, tendon/ muscle groups are stretched to limits of their range. When this occurs, the structures are much more susceptible to damage.

What to Look For

This Job Factor is scored when one or more fingers (or the thumb) is held away from the rest of the hand. Finger/thumb hyperextension describes the activity of over extending (e.g., pointing) the finger or thumb. This Job Factor would be scored if the extension is

Table 7
Checklist Question 7 (cont'd)

beyond a relaxed range of movement or is held in the position for a prolonged period of time.

This Job Factor may also be scored when the task requires repetitive movements of a single finger or the thumb. As a general rule, extension of the fingers would be considered to be *continuously* if the posture is maintained for at least 10 seconds at a time. Finger extension, considered to be *repeated* if the person bends the wrist, on average, every 30 seconds or more frequently.

Examples of hyperextension of finger/thumb include:

- Using pliers or cutting tools with a wide handle span that causes the person to spread the hand wide to operate the tool; and
- Using a scanner with a trigger that is far away from the center of the grip.

Examples of repeated single finger activation include:

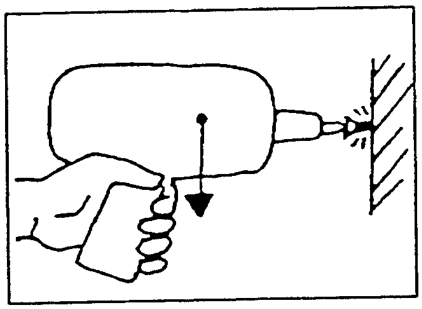
- Using a scanner with a trigger that can only be operated with a single finger trigger; and,
- Pressing buttons or controls.

References: 6, 23, 29

Table 8
Checklist Question 8

Question: **Hand/grip forces:**

Fingertip force: > 2 lb. (0.9 kg) (e.g., 2 lb. is roughly equal to holding fingernail clippers closed)
full hand force: > 8 lb. (3.6 kg) (e.g., 8 lb. is roughly equal to holding a gallon of milk)



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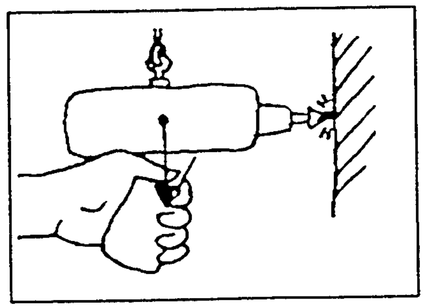

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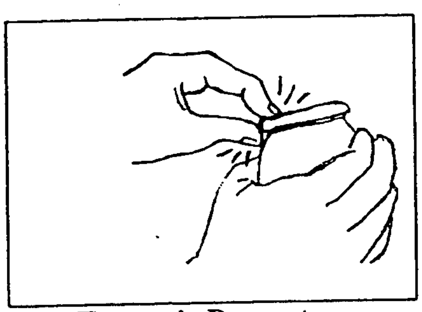

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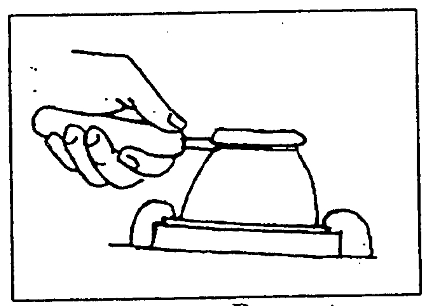


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Stressful Positions or Movements		Exposure to Hard Edges
x	Excessive Forces or Forceful Exertions		Exposure to Vibration
x	High frequency (repetitive) or high speed movements		Temperature Extremes (especially cold)
x	Static (fixed position) work		

Background Discussion

Repeated forceful use of the hands or fingers over a period of time can result in significant stress to the tendons, ligaments, nerve, and other soft tissues. There is an increased likelihood for employees to report discomfort when a job requires forceful use

Table 8
Checklist Question 8 (cont'd)

of the hands or fingers. The presence of this *force* risk factor in a job may be one of the most significant contributors to reports of hand and wrist discomfort for employees in warehouse, materials handling, assembly and service areas.

A common example of high hand forces (see upper left picture) are tools which are heavy or unbalanced (i.e., the center of gravity of the tool is directly above the center of the grip).

What to Look For

This Job Factor is scored when forces are estimated to exceed the guidelines for one of the two different types of grips.

This Job Factor is scored when the fingertip force exceeds 2 lb.(0.9 kg). 2 lb. is roughly equal to holding fingernail clippers closed. A fingertip grip or *pinch grip* involves gripping primarily with the fingertips.

This Job Factor can also be scored when the full hand force exceeds 8 lb. (3.6 kg). This is roughly equal to holding a 8 lb. (3.6 kg) tool or holding a gallon of milk. In order for a grip to qualify as a full hand grip or *power grip* there must be: (1) contact between the object and the palm of the hand and (2) a slight overlap of the thumb and fingers around the object. If both of the conditions are not met, the grip should be considered as a fingertip grip.

Examples of forceful fingertip grips include:

- Using the fingers/finger tips like a biological clamp to stabilize a part; or,
- Picking up grocery items when scanning or bagging; or
- Applying substantial force to insert or remove snap fit components.

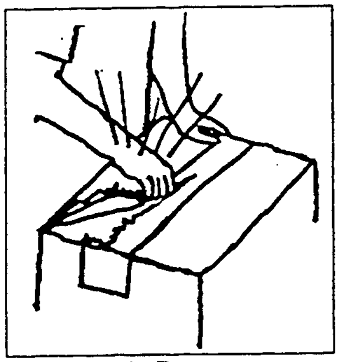
Examples of forceful full handgrips include:

- Holding a heavy power tool that weighs more than 8 lb.; or,
- Trimming meat with a knife.

References: 4, 6, 9, 12, 13, 24

Table 9
Checklist Question 9

Question: **High speed hand/wrist/arm movements** (e.g., yanking a box open, using packing tape dispenser, using the hand as a hammer) **or Vibration, impact, or torque to the hand** (e.g., using a nail gun)



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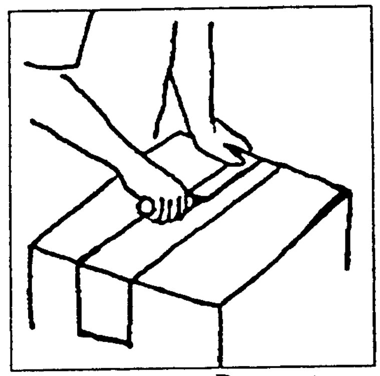

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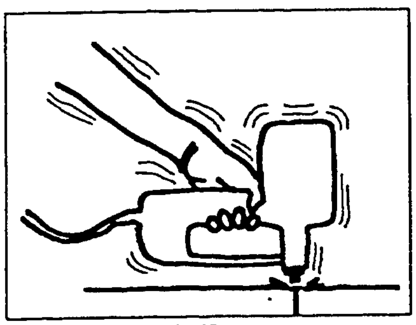

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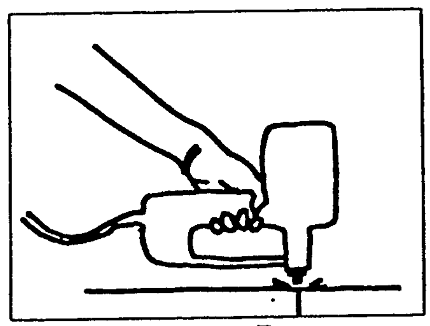


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Stressful Positions or Movements		Exposure to Hard Edges
x	Excessive Forces or Forceful Exertions	x	Exposure to Vibration
x	High frequency (repetitive) or high speed movements		Temperature Extremes (especially cold)
	Static (fixed position) work		

Background Discussion

High-speed hand movements may produce excessive internal forces to the wrist. Excessive forces can damage tendons and nerves over a period of time.

Prolonged exposure to vibration, impact, and torque can reduce circulation and damage soft tissues. Vibrations, impact, and torque also tend to cause the worker to increase the grip to maintain control--creating an additional, compounding Job Factor, force.

Table 9
Checklist Question 9 (cont'd)

What to Look For

This Job Factor is scored when high speed or sudden hand/wrist/arm movements are observed in the task. In some cases, high speed, hand/wrist/arm movements occur in tasks where high forces are also occurring (e.g., removing stuck components).

Examples of high-speed hand/wrist/arm movements include:

- Yanking on a stuck object with fingers to remove it;
- Tearing a boxes apart;
- Repetitive use of a hammer; and,
- Using the hand as a hammer.

This question is also scored if any vibration, impact or torque is observed in the task. For the Level I Checklist there is no minimum intensity for this Job Factor. Regardless of the intensity of the exposure, if vibration, impact or torque is observed in the task, the question is scored.

Note: Measuring vibration exposure requires a detailed evaluation which is beyond the level and scope of this document. If you require evaluation of vibration exposure, contact IERA/RSHE for consultative assistance.

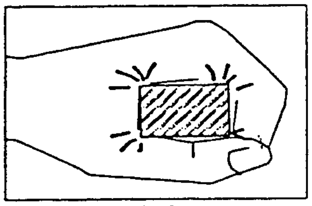
Examples of vibration, impact, or torque to the hand would include:

- Using various types of rotating or oscillating power tools such as power drills, air ratchets, grinders, or sanders; or
- Using various types of tools which deliver a blow or impact such as nail guns, staple guns, or rivet guns.

References: 4, 6, 9, 30

Table 10
Checklist Question 10

Question: **Exposure to hard edges** (e.g., tool handle or work area presses into fingers or holding a box by cut-out handles or strapping)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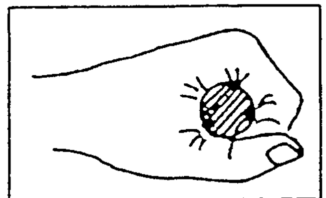

Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Stressful Positions or Movements	x	Exposure to Hard Edges
	Excessive Forces or Forceful Exertions		Exposure to Vibration
	High frequency (repetitive) or high speed movements		Temperature Extremes (especially cold)
	Static (fixed position) work		

Background Discussion

Hard edges which press into the hand, wrist, or arm can place pressure on nerves or tendons which pass close to the surface of the skin. This can result in wear and damage to these structures over a period of time.

What to Look For

This Job Factor is scored when the hands, wrists or arms are exposed to a hard or sharp edges or corners. The term *exposed to a hard edge* means that the hard edge presses into the skin and tissues of the hand, wrist or arm for some portion of the task. Note: If a hard edge is present but does not press into the body, the Job Factor is **not** scored.

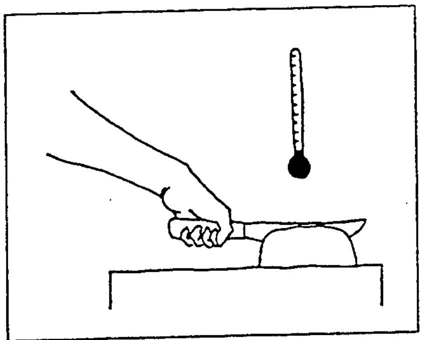
Exposure to hard edges may be caused by:

- Box handles or objects with square corners, protrusions, or hard edges;
- Work surfaces with a square edge (as opposed to a rounded, bull-nose edge); and
- Resting the arms/elbows on equipment to stabilize the hands during work.

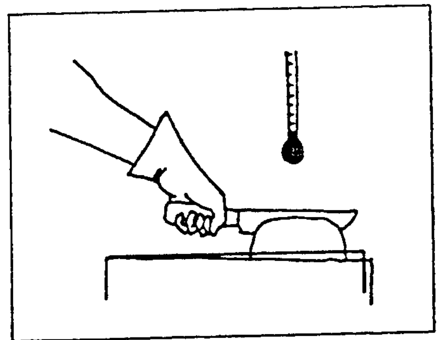
References: 4, 6, 22

Table 11
Checklist Question 11

Question: **Hands and fingers exposed to cold temperatures** (e.g., working outside in winter environment, working in freezers, meat packing)



Factor is Present



Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Stressful Positions or Movements		Exposure to Hard Edges
	Excessive Forces or Forceful Exertions		Exposure to Vibration
	High frequency (repetitive) or high speed movements	x	Temperature Extremes (especially cold)
	Static (fixed position) work		

Background Discussion

Exposure to cold temperatures can reduce blood flow to the fingers and hands. This may cause the body's natural healing process to slow which allows micro-trauma created from exposure to other Job Factors to accumulate more quickly. Flexibility of the tendons and joints may also decrease with a corresponding increase in stress and muscle fatigue.

What to Look For

This Job Factor is scored when the person is in an environment where there is a tendency for the hands and fingers to become cold. Occasional handling of cold items, such as occurs in cashiers, is not scored.

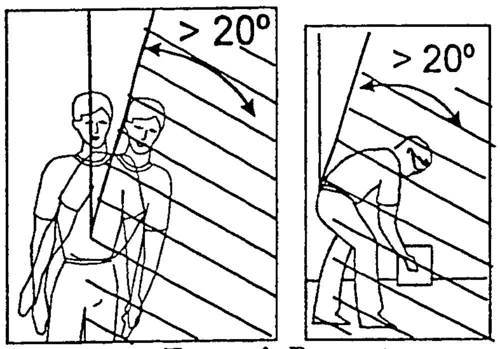
Examples of exposure to cold temperatures include:

- Working in freezers or refrigerators for more than 15 minutes without a break;
- Meat cutting; and,
- Stocking frozen goods.

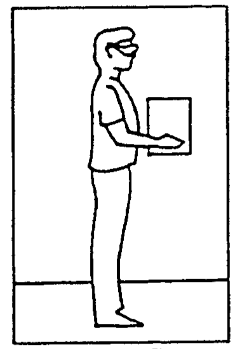
References: 4, 9

Table 12
Checklist Question 12

Question: **Repeated forward or side-ways bending movements** (>20°) (e.g. lifting from floor level)



Factor is Present



Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
x	Awkward Positions or Movements		Static (fixed position) work
	Excessive Forces or Forceful Exertions		Exposure to Vibration
x	High frequency (repetitive) or high speed movements		

Background Discussion

Repeated forward or sideways bending causes the pressure on the muscles and intervertebral discs of the spine to be unevenly distributed. Forward or sideways bending can contribute to muscle fatigue as well increase the potential for back injuries (e.g., sprains/strains, disc herniation).

What to Look For

This Job Factor is scored when the person is bent forward or to the side more than 20° vertical.

As a general rule, bending of the back would be considered to be *repeated* if the person bends the back, on average, every 30 seconds or more frequently.

Examples of repeated forward or side-ways bending movements would include:

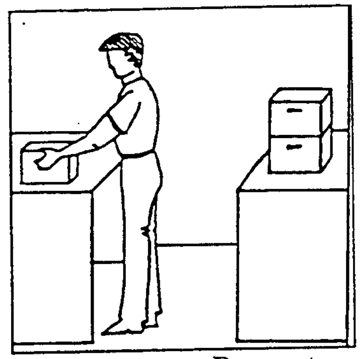
- Handling of items below knee level; and,
- Reaching for tools or objects which are too far away from the worker.

References: 1, 3, 9, 22, 31

Table 13
Checklist Question 13

Question:	**Twisting of the lower back** (e.g. rushing while lifting, pulling, open a stuck door)

Factor is Present



Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
x	Awkward Positions or Movements		Static (fixed position) work
	Excessive Forces or Forceful Exertions		Exposure to Vibration
x	High frequency (repetitive) or high speed movements		

Background Discussion

Twisting may be one of the most damaging movements for the spinal discs because of the shear force created during twisting. Repeated twisting over a period of time can accelerate wear of the cartilage and plates and fibrous tissue of the disc itself.

Table 13
Checklist Question 13 (cont'd)

What to Look For

This Job Factor is scored when twisting of the lower back is observed while the task is being performed.

Due to the difficulty in estimating twisting angle, there is no minimum twist angle required to score this Job Factor. If any twisting of the lower back is observed to reoccur in the task, the Job Factor should be scored.

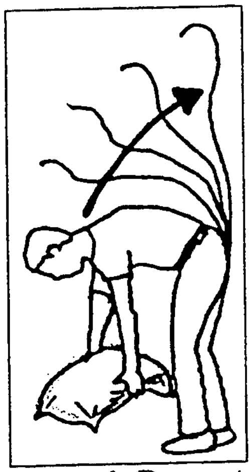
Examples of twisting of the lower back would include:

- Pulling a cart with one hand;
- Turning to transfer an item while standing; or,
- Turning to transfer an object while seated in a chair that does not swivel.

References: 9, 17, 32

Table 14
Checklist Question 14

Question:	**High speed, sudden movements** with the back or **handling awkward, uneven or shifting loads,** (e.g., lifting patients, lifting boxes larger than 30")



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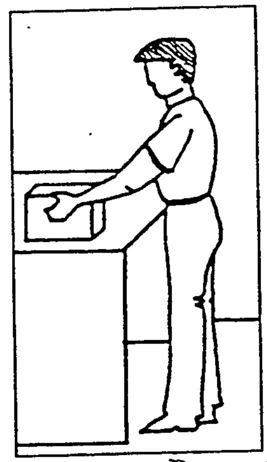


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Awkward Positions or Movements		Static (fixed position) work
	Excessive Forces or Forceful Exertions		Exposure to Vibration
x	High frequency (repetitive) or high speed movements		

Background Discussion

High-speed movements of the back can generate high forces internally throughout the spine, muscles, and other supporting tissues. Research indicates that high-speed movements (acceleration) may increase the risk of back injury.

What to Look For

This Job Factor is scored when jerky or sudden movements of the back are observed while the task is being performed. Awkward or shifting loads often result in sudden movements of the back. It is also common to see sudden movements in tasks which require large forces.

Table 14
Checklist Question 14 (cont'd)

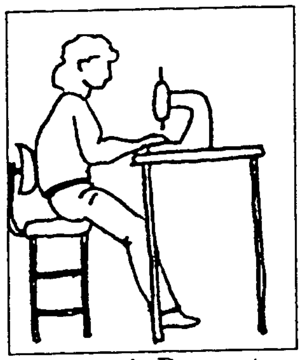
Examples of high speed or sudden movements include:

- Lifting a very heavy object that is difficult to grasp (e.g., patient);
- Opening a stuck door;
- Pushing a large piece of rolling equipment up a ramp, or over a crack in the floor; and
- Rushing while handling an object.

References: 17

Table 15
Checklist Question 15

Question: **Static, awkward back postures** (for >10 sec at a time).
While standing, continuous leaning forward or to the side (>20°), or
While seated, continuous leaning forward (>20°) or poor lower back posture



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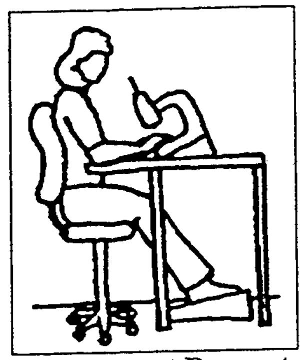

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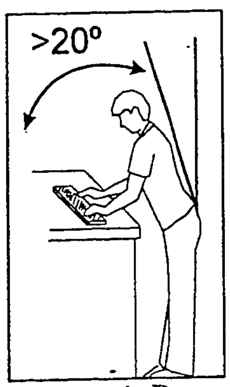


Factor is Present

Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
x	Awkward Positions or Movements	x	Static (fixed position) work
	Excessive Forces or Forceful Exertions		Exposure to Vibration
	High frequency (repetitive) or high speed movements		

Background Discussion

Leaning forward continuously (without support for the body) causes static muscular effort. Static muscular effort produces discomfort in a matter of seconds because the energy stored in the muscle is rapidly depleted and the constricted muscles restrict the flow of energy and oxygen to the muscle.

Table 15
Checklist Question 15 (cont'd)

What to Look For

This Job Factor is scored when the person is observed leaning forward or to the side for a prolonged period of time (at least 10 seconds at a time). Leaning forward becomes a risk factor when the individual maintains this posture for a period of time. It is not as significant a risk factor when the individual is simply making a change in his/her posture.

The Job Factor is scored only if the angle of bending of the upper body with respect to vertical exceeds 20°.

This Job Factor is also scored when a person in a seated position has poor lower back posture. Poor lower back posture is exhibited by a lack of an inward curve in the lower back. That is, the lower back area looks slightly rounded. Poor lower back posture while seated may be caused by lack of adequate lower back support.

Examples of static, awkward back postures would include:

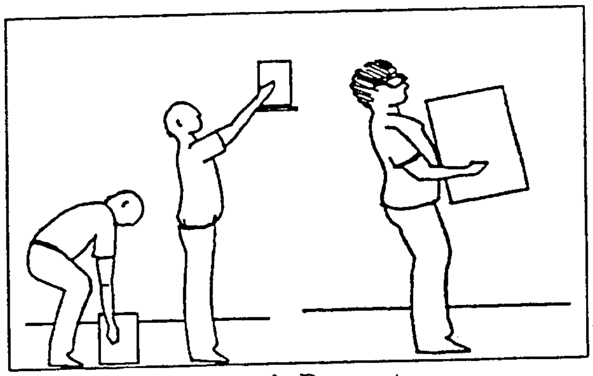
- Leaning forward to perform a task that is too low or too far away;
- Sitting in a chair without a backrest; and,
- Sitting in a chair with a seat pan that is too deep (unable to sit against the backrest).
- Removing groceries from cases when stocking shelves in the commissary.

References: 1, 9, 22, 31

Table 16
Checklist Question 16

Question: **Lifting forces**

50-70 lb. (22.7-31.8 kg.) while upright w/ load close to body, or
10-40 lb. (4.5-18.1 kg.) while bending or reaching.
>70 lb. (31.8 kg.) while upright w/ load close to body, or
> 40 lb. (18.1) while bending or reaching



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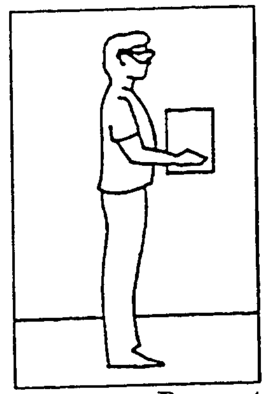


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Awkward Positions or Movements		Static (fixed position) work
x	Excessive Forces or Forceful Exertions		Exposure to Vibration
	High frequency (repetitive) or high speed movements		

Background Discussion

Research has shown that as the forces in the lower back increase, frequency of complaints of lower back pain may increase. Forces can be high due to an awkward body posture (and the resulting additional forces in the back) as well as the weight of the object handled.

What to Look For

This Job Factor may be scored for four different situations:

- When the person handles a 50-70 lb. (22.7-31.8 kg.) object while the torso is upright **and** the elbows are close to the body. The torso can be considered "upright" as long as the person is not bent forward more than 20 degrees from vertical. The elbows can be considered "close" to the body as long as the angle between the torso and upper arm is no greater than 15 degrees. Notice that in order to meet this criteria, both the

Table 16
Checklist Question 16 (cont'd)

back and the arms must be in a good posture. In this example, the body is in a good position but the weight is significant.

- When the person handles a 10-40 lb. (4.5-18.1 kg.) object while the person is bent forward **or** is reaching. (e.g., upper body is bent greater than 20° from vertical or the upper arms are more than 15° from the torso). Notice that this portion of the Job Factor is scored if the person is either bending or reaching (or both bending and reaching) while lifting. In this example, the body is in a stressful position but the weight is minimal.

- When the person handles an object which weighs more than 70 lb. (31.8 kg.) while the upper body is upright **and** the elbows are close to the body (e.g., torso is bent forward no more than 20 degrees and the angle between the upper arm and the torso is no more than 15 degrees). Notice that in order to meet this criterion, both the back and the arms must be in a good posture. In this example, the body is in a good position but the weight is excessive.

- When the person handles an object that weighs greater than 40 lb. (18.1 kg.) while bent forward **or** reaching (e.g., the torso is bent more than 20° from vertical or the upper arms are more than 15° from the body). Notice that this portion of the Job Factor is scored if the person is either bending or reaching (or both bending and reaching) while handling an object. In this example, the body is in a stressful position and the weight is significant.

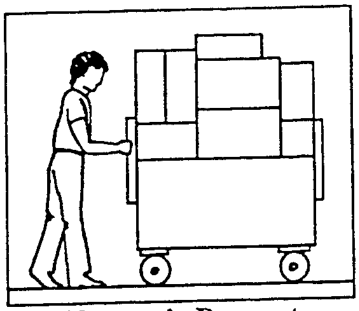
Examples of situations where high lifting forces may be created include:

- lifting/handling heavy boxes or objects;
- lifting objects from floor level;
- lifting or transferring a patient; and,
- Lifting a 2-gallon pail from a shipping pallet and placing it on a high storage shelf.

References: 9, 22, 33

Table 17
Checklist Question 17

Question: **Pushing or pulling** initial force > 50 lb. (22.7 kg.) (e.g.,pushing/pulling a full two-drawer file cabinet across a carpeted floor)



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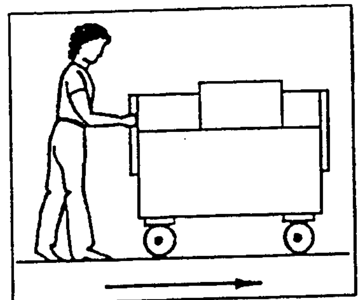


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Awkward Positions or Movements		Static (fixed position) work
x	Excessive Forces or Forceful Exertions		Exposure to Vibration
	High frequency (repetitive) or high speed movements		

Background Discussion

There are several factors that impact the stresses created by pushing and pulling tasks. These factors include: the height of the hands (e.g., shoulder level, waist level, knee level), the distance the object is moved, and the frequency of the activity (e.g., one push/pull every minute or one push every 30 minutes, etc.).

The push/full force reference of pounds 50 pounds (22.7 kg.) is provided to reflect the capabilities of the female population for initial (e.g., get the item moving) push/pull forces. While the actual capabilities of the entire work force vary due to strength, this reference is presented as a starting point and is within the scope of the Level I Analysis. If this Job Factor is found in the job, the user is encouraged to contact DET 1, HSC/OEMO and request a Level II Analysis. The Level II Analysis considers factors like, body/hand position, frequency, distance traveled, as well as weight.

What to Look For

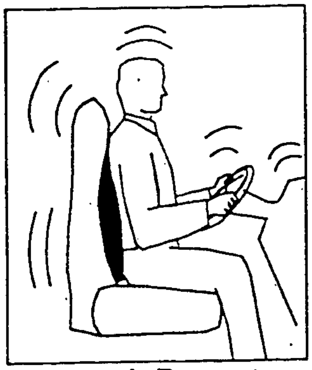
This Job Factor is scored when the person pushes or pulls an object with an initial force of greater than 50 pounds (22.7 kg.) This Job Factor can also be scored if the person shows substantial exertion push or pull the object.

Table 17
Checklist Question 17 (cont'd)

Examples of pushing or pulling include: • Pushing or pulling heavy carts; or • Transporting pallets of material with a hand pallet jack. **References:** 14, 32

Table 18
Checklist Question 18

Question: **Whole body vibration** felt through floor surface (e.g. operating heavy machinery)



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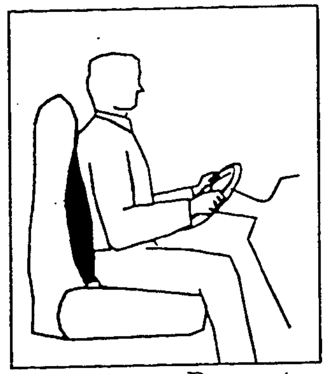


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Awkward Positions or Movements		Static (Fixed Position) Work
	Excessive Forces or Forceful Exertions	x	Exposure to Vibration
	High Frequency (Repetitive) or High Speed Movements		

Background Discussion

Whole body vibration should be considered as a general stressor or secondary risk factor to the body, and the lower back in particular. This is because, while workers exposed to whole body vibration (e.g., long distance truck drivers, heavy equipment operators) have reported muscular and back disorders at a rate greater than that for the general population, a precise cause-effect relationship has not been shown. What seems to be consistent in the research is that potential effect on the employee is most likely in the whole-body resonance frequency range--the range in which there is maximum mechanical vibration energy transfer between the vibration source and the body with an actual amplification of the vibration by the body. For sitting tasks, the frequency range is 3-5 Hz. For standing tasks, the range is 4-7 Hz. Since the measurement of vibration is well beyond the scope of the Level I Assessment, any questions about vibration exposure should be directed to DET 1, HSC/OEMO.

What to Look For

This Job Factor is scored, when the person is exposed (any level) to whole body vibration. Whole body vibration is typically transmitted through a floor surface or seat. There is no minimum intensity for this Job Factor.

Table 18
Checklist Question 18 (cont'd)

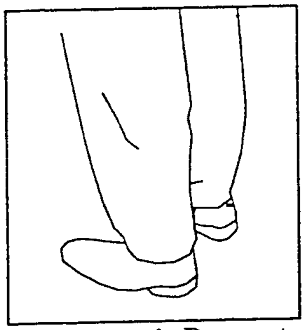
Examples of situations where whole body vibration may be present include:

- Operation of heavy equipment such as back hoes, bulldozers, or cranes, or fork trucks; and
- Working on or around large pieces of machinery.

References: 9, 34, 35, 36

Table 19
Checklist Question 19

Question: **Fixed position, standing** static effort in legs (e.g., standing for prolonged periods



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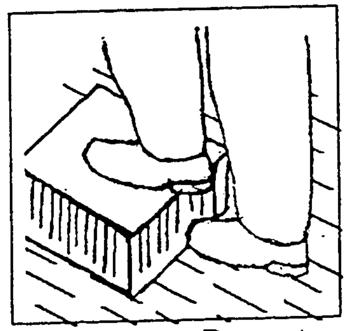


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Stressful Positions of Movements	x	Static (Fixed Position) Work
	Excessive Forces		Exposure to Hard Edges

Background Discussion

Standing in one position for prolonged periods can contribute to pooling of the blood in the veins especially in the lower leg. Such conditions can contribute to varicose veins, swelling of the tissues in the lower legs and feet, and blisters in the swollen areas. Prolonged standing can also increase muscle fatigue in the lower back.

What to Look For

This question is scored when the person is observed standing in a fixed position for prolonged periods of time (e.g., 30 minutes at a time or longer) on a hard floor surface (such as concrete or tile). The question is not scored if the person walks throughout the task.

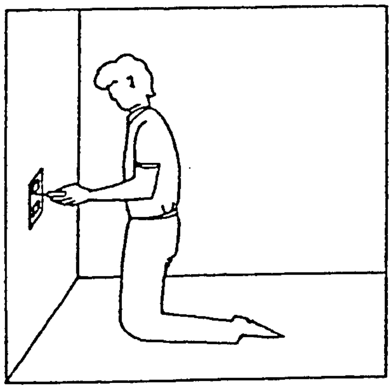
Examples of standing in a fixed position would include:

- Working in the commissary slicing meat; or
- Working at a cash register.

References: 3, 22, 37

Table 20
Checklist Question 20

Question: **Exposure to hard edges on legs, knees, and feet** (e.g., kneeling on a hard surface, leaning against a hard edge, exposure to hard front edge of seat) <u>or</u> **Standing on hard surfaces.**



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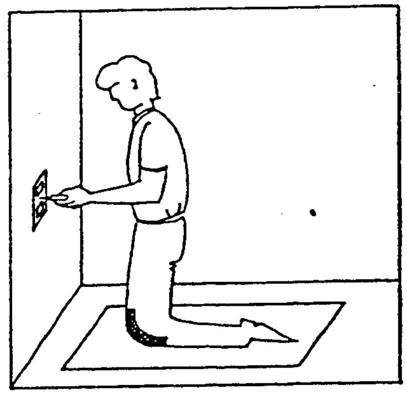

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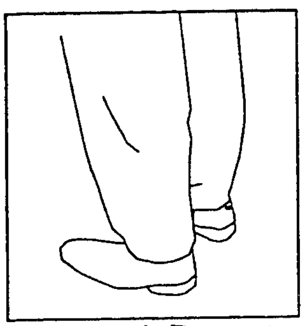

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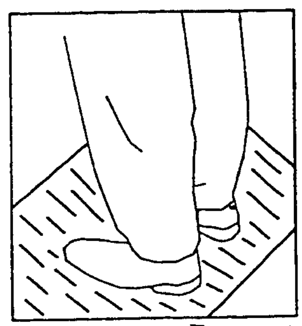


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Stressful Positions of Movements		Static (Fixed Position) Work
	Excessive Forces	x	Exposure to Hard Edges

Background Discussion

Hard edges which press into the legs or buttocks can place pressure on muscles, vessels, nerves, and other soft tissue which pass close to the surface of the skin. Pressure on these tissues can restrict circulation and impact sensation. Standing on hard surface places additional stress on the soft tissues of the foot.

Table 20
Checklist Question 20 (cont'd)

What to Look For

This Job Factor is scored when the legs, knees or feet are exposed to a hard or sharp edge which presses into the skin while tasks are being performed. This Job Factor is also scored when a person stands for a prolonged period of time without anti-fatigue matting. Note: Sharp edges may exist in the work area. If they do not contact the body, this Job Factor is not scored.

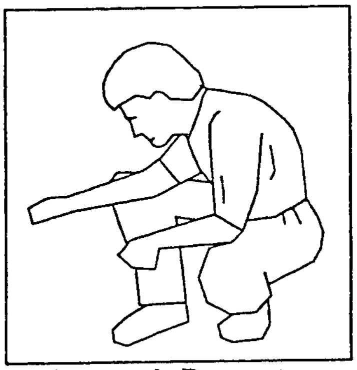
Examples of exposure to hard edges on legs, knees, and feet would include:

- Leaning forward against a hard edge to stabilize the body;
- Kneeling on a hard surface such as metal or concrete;
- Standing for prolonged periods on a hard surface such as concrete or tile;
- Standing for prolonged periods on round or narrow rung of an extension ladder; or,
- While sitting, the hard front edge of the seat presses into the back of the legs.

References: 22

Table 21
Checklist Question 21

Question: **Awkward leg postures** (e.g. kneeling, squatting)



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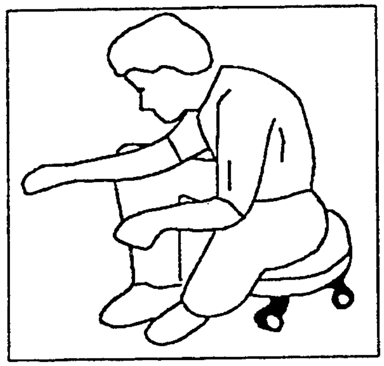


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
x	Stressful Positions of Movements		Static (Fixed Position) Work
	Excessive Forces		Exposure to Hard Edges

Background Discussion

Kneeling or squatting for extended periods of time can create stress and strain on the ligaments of the knee. Kneeling can also create direct pressure on the bursa sac in the knee joints and causes inflammation or bursitis of the knee.

What to Look For

This question is scored when the legs are in an awkward posture repeatedly or for a prolonged period of time (greater than 10 seconds at a time). These awkward postures include squatting, kneeling, crawling on hands and knees, or knee hyperextension. Knee hyperextension is an over extension of the lower leg (leg looks like it is bent backwards at the knee) which increases the pressure in the knee joint.

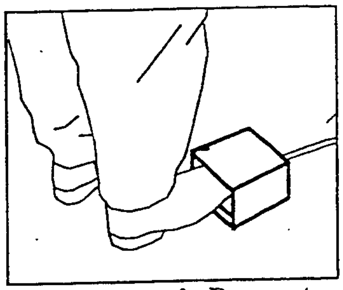
Examples of awkward leg postures include:

- Kneeling or squatting to inspect items on a pallet;
- Leaning forward over a bin or box to access the contents (knee hyperextension); or,
- Repeated kneeling or squatting to access items that are stored near floor level.

References: 38, 39

Table 22
Checklist Question 22

Question: **Awkward foot postures** (e.g., using foot pedal while standing, squatting, standing on tip toes)



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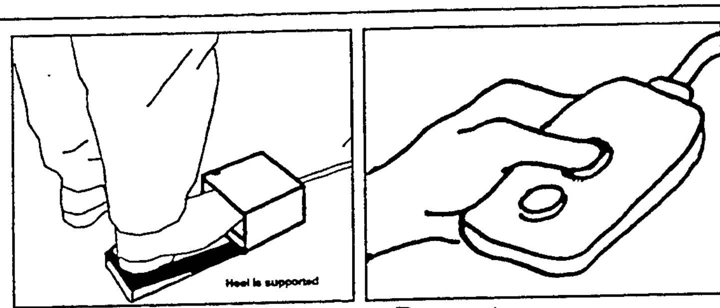


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
x	Stressful Positions of Movements	x	Static (Fixed Position) Work
	Excessive Forces		Exposure to Hard Edges

Background Discussion

Use of foot pedals while standing can create problems for the back as well as the legs by causing the back to be in an unbalanced posture for prolonged periods of time. Use of foot pedals are of concern when the foot must be on the pedal continuously, when the legs cannot be alternated on the foot pedal, or when the person cannot rest the heel while actuating the pedal.

What to Look For

This Job Factor is scored when the person is required to use foot pedal while standing and when the position of the foot pedal leg looks different from the position of the support leg.

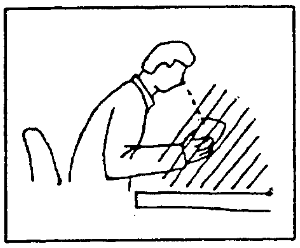
Examples include:

- Using a foot pedal while operating a height adjustable lift table; or
- Using a foot pedal while operating a fork truck.

References: 22, 37

Table 23
Checklist Question 23

Question: **Difficult to see/light levels too low /glare** (e.g., searching under vehicles for lubrication points).



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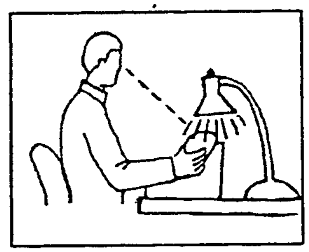


Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
x	Excessive Glare/Excessive Light		Static (fixed position) work
x	Inadequate Light		

Background Discussion

Light levels that are too low or too high can increase the potential for eyestrain and errors. Light levels which are too low tend to produce low contrast, requiring the eyes to work harder to see. Light levels that are too high tend to increase glare. The inappropriate light level may decrease employee performance in visual inspection tasks as well as during computer use.

What to Look For

This Job Factor is scored when the lighting conditions are poor (too high or too low) for performing the required tasks.

The desired light levels vary depending upon the type of task performed.

Task	Recommended Light Levels in foot-candles (lux)
Working spaces where visual tasks are not generally performed (e.g., hallways)	10-20 (100-200 lux)
Rough bench work and machine work (e.g., cutting pieces, building crates, bulk packaging)	20-50 (200-500 lux)
Reading computer screen	20-50 (200-500 lux)
General inspection, fine assembly (e.g., using a lathe, sanding, polishing)	50-100 (500-1,000 lux)
Extra fine bench and machine work, extra fine assembly, detailed inspection (e.g., electronic maintenance, inspecting for surface defects)	500-1,000 (5,000-10,000 lux)

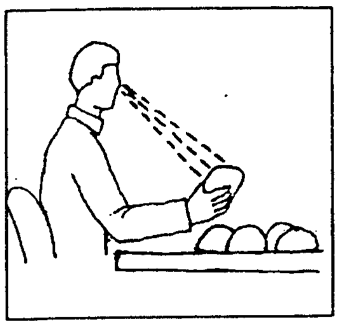
Examples of difficult visual conditions include:

- Inadequate lighting while washing pots and pans; or,
- Inadequate lighting while disassembling oxygen masks.

References: 21

Table 24
Checklist Question 24

Question: **Intensive visual tasks, staring at work objects for long periods** (e.g., visual inspection of small parts).



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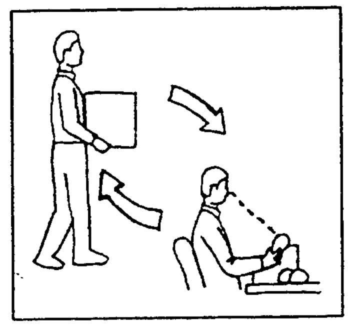

Factor not Present

Targeted Risk Factors

	Risk Factor		Risk Factor
	Excessive Glare/Excessive Light	x	Static (fixed position) work
	Inadequate Light		

Background Discussion

Intensive visual demands that occur over a prolonged period of time can contribute to eyestrain because of static muscular effort imposed on the eye muscles.

What to Look For

This Job Factor is scored when the person performs intensive visual tasks that involve continuous inspection, monitoring or staring at work objects or a screen. The key characteristic is **continuous** and **intensive** staring and the deliberate focusing of attention. Most of the tasks that you will encounter in the maintenance and inspection environment will not involve intensive visual tasks.

Examples of intensive visual tasks include:

- Assembling oxygen masks and other survival equipment; and
- Conducting inventories.

References: 40

Table 25
Checklist Question 25

Question: Restricted space

Targeted Risk Factors

	Risk Factor		Risk Factor
	Excessive Noise		Extreme Temperatures
x	Awkward body postures/movements		Poor Air Quality

Background Discussion

Restricted space is not the same as "confined space." Space is often restricted when there is limited access to where the work must be performed such as reaching through a small access panel to repair a fuel line. If adequate space is not available, the individual may have difficulty performing the task efficiently. Productivity may also be compromised.

What to Look For

This Job Factor is scored when the person works in a workspace that is physically inadequate in size for the tasks performed, such as access panels, or fuel cell work. If there are obstacles that interfere with movement and performance of tasks this question should also be scored.

Examples of restricted space include:

- Picking supplies in a crowded, congested supply crib; and,
- Working underneath vehicles lubricating.

References: 41

Table 26
Checklist Question 26

Question: **Extreme temperatures** – heat or cold.

Targeted Risk Factors

	Risk Factors		Risk Factors
	Excessive Noise	x	Extreme Temperatures
	Static Work Postures		Poor Air Quality

Background and Discussion

Most individuals feel comfortable in a work environment when the air temperature is between 68°- 76° F or 20 - 26° C. The normal body temperature is 98.6° F (37° C). In the summer, skin temperature is around 95° F (37° C) and in the winter is approximately 91.4° F (33° C). Many Warehouse and Service (W/S) tasks occur in warehouses where temperature cannot be controlled to maximize worker comfort. In addition, some W/S tasks occur in freezers (e.g., meat cutting). Extreme conditions can not always be controlled due to hygeine requirements. Uncontrolled temperature extremes should be scored.

What to Look For

Extreme temperatures, chronically low or high temperatures, or extreme fluctuation in temperature in the work environment. Individuals may complain of being too cold or too hot affecting their ability to concentrate or increasing their feeling of fatigue especially when the individual feels too warm. Ask the employee to help you rate this risk factor based on their perception. If the employee comments that the temperature is always a problem or that the temperature reaches extreme levels, mark the *strongly agree response*. If the employee simply states that temperature is *sometimes* a problem, mark the *agree response*.

References: 41, 42

Table 27
Checklist Question 27

Question: **Noise or distractions**

Targeted Risk Factors

	Risk Factors		Risk Factors
x	Excessive Noise		Extreme Temperatures
	Static Work Postures		Poor Air Quality

Background Discussion

In the work environment, there are many sources of noise including:

- Machinery, equipment, generators or AGE;
- Power tools;
- Aircraft, engines (operative and testing);
- Pressurized systems (airlines, compressors); or
- HVAC systems.

Not only can noise from these sources be annoying and create distractions for the worker, prolonged exposure to excessive noise may cause permanent hearing loss.

What to Look For

You may answer the question in two ways. First, ask the employee about his/her perception of noise. Check off the appropriate response. Second, review AFOSH STD 48-19, (Chapter 2) and previous industrial hygiene noise surveys performed for the shop. If noise levels can be controlled with hearing protection, check the *neutral* response. If noise levels are controlled with hearing protection **but** employees still complain about noise, check the *agree* response.

References: 41, 43, 44

Table 28
Checklist Question 28

Question: Air quality concerns

Targeted Risk Factors

	Risk Factors		Risk Factors
	Excessive Noise		Extreme Temperatures
	Static Work Postures	x	Poor Air Quality

Background Discussion

The air quality issue is complex. Work environments can contain a number of air, contaminants and odors. Odors do not necessarily represent a hazardous condition. Lack of odors, on the other hand, does not necessarily represent a safe condition (e.g., carbon monoxide).

What to Look For

It is not the purpose of the Level I Checklist to determine/identify exposures to potentially unsafe air contaminants. These assessments and measurements are performed as part of industrial hygiene surveys. Rather, the purpose of the Level I checklist *air quality concerns* question is to identify if employees perceive that there is a problem. Concern may increase physiological stress and the potential impact of exposure to other risk factors. Ask the employee to help you rate air quality concerns. If a concern is indicated, you may need to review results of past industrial hygiene surveys or evaluate the need for BEF to perform additional surveys.

References: 41, 42

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This Glossary also provides a completed Level I Ergonomics Assessment Checklist. For the job analyzed, please note the following it included:

- A description of the job analyzed;
- A separate analysis for each task;
- Lists of potential work area causes; and,
- A listing of potential solutions.

Note: As you gain experience using the Level I Ergonomics Assessment Checklist and with ergonomics in general, your reliance on this Glossary should decrease significantly.

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SAMPLE LEVEL I ERGONOMICS ASSESSMENT CHECK LIST

Level I Ergonomics Assessment Checklist for Warehouse and Assembly Work Areas	Survey Date (YYMMDD) 98-06-09	Workplace Identifier:	N/A
(use this space for mechanical imprint)		Base Hill AFB	Organization DeGA
		Workplace Commissary	
		Bldg. No/Location 1320	Room/Area Deli
		AFSC/Job Series GS02097	
		Job Name: Food Service	

BEF Technician: ______________________________
Sign

Part I - Work Content (Description of Tasks Performed)

Technician: M. Herbert

Date: 98-06-09

For this section, work with the employee to determine those reoccurring jobs/tasks that are most difficult on the body. Ask the employee the following questions:

- "In terms of stress to the body, what are the most difficult, fatiguing jobs/tasks that you do?"
- "Which of those jobs/tasks do you perform on a regular basis (or occur most frequently)?"

Using the Assembly and Warehouse Task Key List as a reference, write in the task names in the work content matrix below. If the employee mentions tasks which are not included on the Task Key List, write-in the additional tasks in the Task Key List. **Note: If the person mentions several jobs which each have multiple tasks, complete a separate checklist for each job.**

For each task performed, determine the approximate task frequency using the following proportions of job time:

> 50 % (High): The total percentage of work time spent performing the task is greater than 50%.

10-50 % (Moderate): The total percentage of work time spent performing the task is between 10 and 50%.

< 10 % (Low): The total percentage of work time spent performing the task is less than 10%.

For each task, check the most appropriate circle in the Work Content Matrix below to indicate approximate task frequency. If lifting/high force exertions occur in the task, indicate by checking the appropriate circle.

WORK CONTENT MATRIX

Task	Lifting / Exertion Occur in Task	Task Frequency (Check one)		
		(Low) 0-9%	(Moderate) 10-50%.	(High) 51-100%
1. Food Serving	●	○	○	●
2. Dishwashing	○	○	●	○
3.	○	○	○	○
4.	○	○	○	○
5.	○	○	○	○
6.	○	○	○	○

= Critical tasks are indicated by the shaded boxes in the Work Content Matrix. Critical tasks are tasks which occur greater than 10% of the job time or which involve lifting or high forces.

ONLY COMPLETE THE CHECKLIST FOR CRITICAL TASKS.
LOW FREQUENCY TASKS WITH LIFTING OR EXERTION ARE SCORED AS MODERATE FREQUENCY.

Performance Measures

How is your performance measured? Performance is measured by customer comments and by periodic reviews.

Part I – Work Content (Description of Tasks Performed) (Cont.)

Warehouse and Assembly Task Key List

1. Bagging
2. Baking
3. Commissary/Meat Cutting
4. Cooking (Food Preparation)
5. Cooking (Short Order Grill)
6. Dishwashing
7. Food Serving
8. Fork Truck Operating (sitting)
9. Fork Truck Operating (standing)
10. Inspect and Repair Support Equipment
11. Loading/Unloading
12. Lubricating
13. Molding
14. Packing/Shipping
15. Palletizing
16. Patient Handling
17. Picking/Stocking
18. Scanning Bar Code Reader (Hand-held)
19. Scanning (Groceries)/Tendering
20. Transporting Loads on Non-Powered Carts

22. (M&I) Revised Lifting

Part II - Checklist, Shoulder / Neck

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

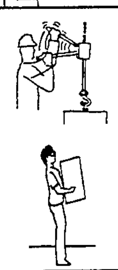
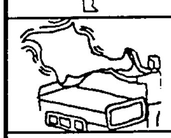
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasionally (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	**Task Name:** Serving		**Task Name:** Dishwash		**Task Name:**		**Comments**
		Task Frequency		**Task Frequency**		**Task Frequency**		
		Moderate 10-50%	**High 51-100%**	**Moderate 10-50%**	**High 51-100%**	**Moderate 10-50%**	**High 51-100%**	
	1. **Reaching** *repeated reaching or arms held continuously away from body while unsupported*							
 30 - 90°	*Below shoulder level (arm 30-90° away from body)*	F S O N 1 1 0 0 **OR**	F S O N 3 2 1 0 **OR**	F S O N 1 1 0 0 **OR**	F S O N 3 2 1 0 **OR**	F S O N 1 1 0 0 **OR**	F S O N 3 2 1 0 **OR**	Reaching for food Cleaning the
 > 90°	*Above shoulder level (arm > 90° away from body)*	F S O N 3 2 1 0	F S O N 4 3 1 0	F S O N 3 2 1 0	F S O N 4 3 1 0	F S O N 3 2 1 0	F S O N 4 3 1 0	inside of hoods
	2. **Arm forces:** **Repeated arm forces** exceeding 10 lb. (4.5 kg.) *(e.g. roughly equivalent to lifting a gallon of milk)* ***or*** **Holding/carrying materials** *exceeding 25 lb.(11.3kg.) for more than three steps*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	Lifting food trays Scrubbing
	3. **High speed, sudden shoulder movements** *(e.g., opening a stuck door, pulling and yanking on a bed linens to remove them)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	Scrubbing
	4. **Head/neck bent, tilted, or twisted** (>10°) *(e.g., scale display too high or too far away from scale)*	F S O N 3 2 1 0	F S O N 6 3 1 0	F S O N 3 2 1 0	F S O N 6 3 1 0	F S O N 3 2 1 0	F S O N 6 3 1 0	Work area too low
	Task Scores = (column total)		6	7				

Part II - Checklist, Hands/Wrists/Arms

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

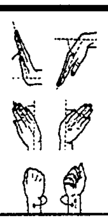
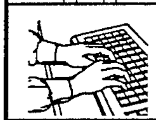
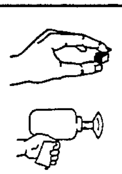
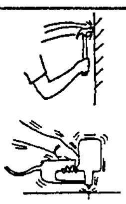
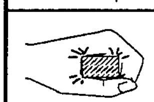
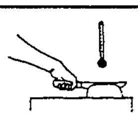
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasionally (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	Task Name: Serving		Task Name: Dishwash		Task Name:		Comments
		Task Frequency		Task Frequency		Task Frequency		
		Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	
	5. **Bent wrists/repeated wrist movements** (>10° in any direction) **or repeated forearm rotation** *(e.g., scanning groceries, washing dishes)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	6. **Repeated manipulations with fingers** *(e.g., repetitive keying tasks, operating buttons on hand-held scanners)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 1 0 0 0	F S O N 2 1 0 0	
	7. **Hyperextension of finger/thumb** *(e.g., using pliers with a wide handle span)* **or repeated single finger activation** *(e.g., single finger triggers on power tools)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 1 0 0 0	F S O N 3 1 0 0	
	8. **Hand/grip forces** <u>*fingertip force:*</u> *> 2 lb.(.9 kg.) (e.g., 2 lb. is roughly equal to holding fingernail clippers closed* <u>*full hand force:*</u> *> 8 lb. (3.6 kg.) (e.g., 8 lb. is roughly equal to holding a gallon of milk)*	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	Scrubbing up dried food
	9. **High speed hand/wrist /arm movements** *(e.g., yank a box open, using a packing tape dispenser)* <u>**or**</u> **Vibration, impact, or torque to the hand** *(e.g., using a nail gun)*	F S O N 3 1 0 0	F S O N 5 2 1 0	F S O N 3 1 0 0	F S O N 5 2 1 0	F S O N 3 1 0 0	F S O N 5 2 1 0	
	10. **Exposure to hard edges** *(e.g., tool handle or work area presses into fingers or hand, holding a box by cut-out handles or strapping)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	11. **Hands and fingers exposed to cold temperatures** *(e.g., working outside in winter environment, working in freezers, meatpacking)*	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	Refrigerated foods Metal spoons
	Task Scores = (column total)		4	4				

Part II - Checklist, Back/Torso

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

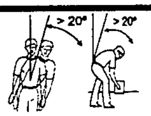
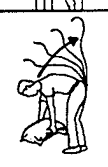
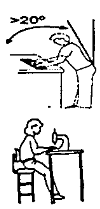
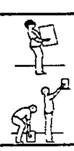
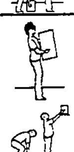
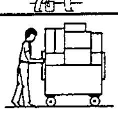
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasionally (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	Task Name: Serving — Task Frequency: Moderate 10-50%	Task Name: Serving — Task Frequency: High 51-100%	Task Name: Dishwash — Task Frequency: Moderate 10-50%	Task Name: Dishwash — Task Frequency: High 51-100%	Task Name: — Task Frequency: Moderate 10-50%	Task Name: — Task Frequency: High 51-100%	Comments
	12. **Repeated forward or sideways bending movements** (>20°) (e.g. lifting from floor level)	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	Serving food Cleaning
	13. **Twisting of the lower back** (e.g. rushing while lifting, pulling, open a stuck door)	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	Reaching for food Cleaning hoods
	14. **High speed, sudden movements** *with the back* **or Handling awkward, uneven or shifting loads,** *(e.g., lifting patients, lifting boxes larger than 30")*	F S O N 3 2 2 0	F S O N 4 3 2 0	F S O N 3 2 2 0	F S O N 4 3 2 0	F S O N 3 2 2 0	F S O N 4 3 2 0	
	15. **Static, awkward back postures** *(for >10 sec at a time)* ***While standing,*** *continuous leaning forward or to the side* (>20°) **or** ***While seated,*** *continuous leaning forward* (>20°) *or poor lower back posture*	F S O N 2 1 0 0	F S O N 6 2 1 0	F S O N 2 1 0 0	F S O N 6 2 1 0	F S O N 2 1 0 0	F S O N 6 2 1 0	Serving food Cleaning
	16. **Lifting forces**							
	• *50-70 lb. (22.7-31.8 kg.) while upright w/ load close to body or* • *10-40 lb. (4.5-18.1 kg.) while bending or reaching*	F S O N 3 2 2 0 **OR**	F S O N 4 3 2 0 **OR**	F S O N 3 2 2 0 **OR**	F S O N 4 3 2 0 **OR**	F S O N 3 2 2 0 **OR**	F S O N 4 3 2 0 **OR**	Carrying food trays Carrying water buckets
	• *> 70 lb.(31.8 kg.) while upright w/ load close to body or* • *> 40 lb. (18.1 kg.) while bending or reaching*	F S O N 6 5 4 0	F S O N 7 6 4 0	F S O N 6 5 4 0	F S O N 7 6 4 0	F S O N 6 5 4 0	F S O N 7 6 4 0	
	17. **Pushing or pulling** *(initial force > 50 lb. (22.7 kg.) (e.g. pushing/pulling a full two-drawer file cabinet across a carpeted floor)*	F S O N 3 2 1 0	F S O N 4 3 2 0	F S O N 3 2 1 0	F S O N 4 3 2 0	F S O N 3 2 1 0	F S O N 4 3 2 0	
	18. **Whole body vibration** *felt through floor surface (e.g. operating a fork truck)*	F S O N 2 1 0 0	F S O N 4 2 1 0	F S O N 2 1 0 0	F S O N 4 2 1 0	F S O N 2 1 0 0	F S O N 4 2 1 0	
	Task Scores = (column total)		7	5				

Part II - Checklist, Legs/Feet

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

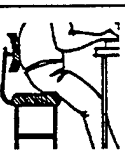
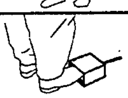
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasionally (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

		Task Name: Serving		**Task Name:** Dishwash		**Task Name:**		**Comments**
		Task Frequency		**Task Frequency**		**Task Frequency**		
Job Factor		**Moderate 10-50%**	**High 51-100%**	**Moderate 10-50%**	**High 51-100%**	**Moderate 10-50%**	**High 51-100%**	
	19. **Fixed position, standing** *static effort in legs (e.g. standing for prolonged periods)*	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	20. **Exposure to hard edges on legs, knees, and feet** *(e.g., kneeling on a hard surface, leaning against a hard edge, exposure to hard front edge of seat)* **or Standing on hard surfaces.**	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	21. **Awkward leg postures** *(e.g. kneeling or squatting)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	22. **Awkward foot postures** *(e.g., using foot pedal while standing, squatting, standing on tip toes)*	F S O N 1 0 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 3 2 1 0	
	Task Scores = (column total)		3	4				

Part II - Checklist, Head/Eyes

Job Factors

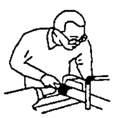
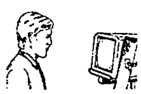
For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasionally (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

		Critical Tasks						
		Task Name: Serving		Task Name: Dishwash		Task Name:		Comments
		Task Frequency		Task Frequency		Task Frequency		
	Job Factor	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	
	23. **Difficult to see/light levels too low /glare** *(e.g. searching under vehicles for lubrication points)*	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	24. **Intensive visual tasks, staring at work objects for long periods** *(e.g., visual inspection of small parts)*	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	Task Scores = (column total)		1	0				

Part III - Environmental

Environmental Factors

	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
25. Restricted space	0	0	0	1	4
26. Extreme temperatures heat/cold	0	0	0	1	4
27. Noise or distractions	0	0	0	1	4
28. Air quality concerns	0	0	0	1	4

Environmental Score = 2

Environmental Rating	Low	Med	High
Environmental Score	0-3	4-7	8+

Part IV - Employee Suggestion

Ask the employee for any suggestions for corrective actions that they may have.
Provide lighter weight food trays.

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APPENDIX 3

Prioritization of Hazards

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APPENDIX 3

This Appendix corresponds with Step 3: Prioritization of Hazards and includes:

- completed example of a Checklist Scoring Summary form.

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SAMPLE CHECKLIST SCORING SUMMARY

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CHECKLIST SCORING SUMMARY

Technician: M. Herbert **Date :** 98-06-09

Scoring Summary: Transfer scores from individual scoring sheets.

Body Region	Task Scores					Priority Score by Body Region	Priority Rating by Body Region
	Task Name: Food Serving	Task Name: Dish-washing	Task Name:	Task Name:		Add across row and divide by # of tasks for average	High: 8+ Med: 4-7 Low: 0-3
Shoulder/Neck	6	7	*note: 6.5 was rounded up to 7*		=	*7	High Med Low
Hand/Wrist/Arm	4	4			=	4	High Med Low
Back/Torso	7	5			=	6	High Med Low
Legs/Feet	3	4	*note: 3.5 was rounded up to 4*		=	*4	High Med Low
Head/Eyes	1	0	*note: .5 was rounded up to 1*		=	*1	High Med Low

Select the highest body region score for each task then circle below for High, Med, Low	Highest Score	Highest Score	Highest Score	Highest Score	Environmental Rating
	7	5			
High: 8+ Med: 4-7 Low: 0-3	High Med Low	High Med Low	High Med Low	High Med Low	High Med Low

Overall	
Highest Priority Score by Body Region	Overall Priority Rating
7	**High** **Med** **Low**

3. **<u>Case Study Selections List</u>** Select the case studies that match the critical tasks that you identified for this job. Place a ✓in the appropriate boxes below and then turn to the appropriate case study in the Case Study Book.

1. Bagging	❑	12. Lubricating	❑
2. Baking	❑	13. Molding	❑
3. Commissary/Meat Cutting	❑	14. Packing/Shipping	❑
4. Cooking (Food Preparation)	❑	15. Palletizing	❑
5. Cooking (Short Order Grill)	❑	16. Patient Handling	❑
6. Dishwashing	■	17. Picking/Stocking	❑
7. Food Serving	■	18. Scanning/Bar Code Reader (Hand-held)	❑
8. Fork Truck Operating (sitting)	❑	19. Scanning Groceries/Tendering	❑
9. Fork Truck Operating (standing)	❑	20. Transporting Loads on Non-powered Carts	❑
10. Inspect and Repair Support Equipment	❑	22. (M & I) Revised Lifting	❑
11. Loading/Unloading	❑		

APPENDIX 4

Hazard Control Section

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APPENDIX 4

Case Study Problem-Solving Matrices for Warehouse and Assembly Work Areas.

This Appendix includes:

- a sample completed Corrective Actions List; and
- 20 case studies.

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CASE STUDY PROBLEM-SOLVING MATRICES

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The 20 case study problem-solving matrices provided on the following pages link the problems identified with the Level I Ergonomics Assessment Checklist and Checklist Scoring Summary to strategies or options which you may use to control ergonomics hazards. The matrices are presented in Table 1 below.

Table 1
Directory of Case Study Problem-Solving Matrices

Case Study	
1. Bagging	12. Lubricating
2. Baking	13. Molding
3. Commissary/Meat Cutting	14. Packing/Shipping
4. Cooking (Food Preparation)	15. Palletizing
5. Cooking (Short Order Grill)	16. Patient Handling
6. Dishwashing	17. Picking/Stocking
7. Food Serving	18. Scanning Bar Code Reader (Hand-held)
8. Fork Truck Operating (sitting)	19. Scanning (Stationary)/Tendering Money
9. Fork Truck Operating (standing)	20. Transporting Loads on Non-Powered Carts
10. Inspect and Repair Support Equipment	
11. Loading/Unloading	22. Lifting

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CASE STUDY – Bagging	
TASK TITLE: Bagging	
Task Description:	The Bagging task may be involved when working in a deli, grocery store, convenience store or commissary. Bagging tasks involve placing scanned or checked items in plastic or paper bags. This case study does not include scanning / bar coding items with a stationary or hand-held scanner. Please see the Case Study 19 - Scanning Groceries / Tendering Money for issues concerning other aspects of checkout. Typical jobs in which Bagging tasks are performed include (but are not necessarily limited to): • Commissary • Convenience store • Restaurant
Job Performance Measures Most Often Impacted by Bagging:	Measures of job performance can include (but are not limited to): • Time required to complete task
Typical Employee Comments about Bagging:	Employees typically experience discomfort in the back and shoulders. The shoulder/neck and back/torso are the body areas that most commonly receive a “High” priority rating. The remaining areas, with the exception of the head/eyes, are more likely to receive a “Medium” priority rating, or lower.
Suggested Level II Analysis:	Postural Analysis, Biomechanical Lifting Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Object must be lifted over bag's edge before lowered	150.Re-design work space • place the bagging area directly beside the individual rather than off to one side	✓		low	low	med
		• lower the bag so that items are dropped into the bag rather than raising the item to clear the edge of the bag	✓		low	low	med
2. Arm forces: Repeated arm forces or holding / carrying materials	• Rarely occurs	N/A					

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements	• Speed of lift	11. Eliminate unnecessary tasks					
		• implement an advanced checkout system that has clients bag their own items		✓	high	high	high
		13. Encourage ergonomic work techniques					
		• encourage person to use smooth fluid movements while handling items.	✓		low	low	low
		• encourage person to use smooth fluid movements to bring grocery items towards them	✓		low	low	low
4. Head/neck bent or twisted	• Rarely occurs	N/A					

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Shape of item causes awkward wrist positions when bagging	13. Encourage ergonomic work techniques • use two hands to lift heavy awkward items	✓		low	low	low
		25. Increase task variety • alternate work tasks to avoid handling groceries for extended periods of time	✓		low	low	low
		20. Incorporate rest pauses	✓		low	low	low
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Item is difficult to grasp 	13. Encourage ergonomic work techniques • push instead of grab and lift • use two hands to lift heavy or awkward items	✓ ✓		low low	med low	med low
		11. Eliminate unnecessary tasks • implement an advanced checkout system that has clients bag their own items		✓	high	high	high
8. Hand/grip forces	• Item is difficult to grasp • Item has no handles	13. Encourage ergonomic work techniques • leave heavy items in the grocery cart	✓		low	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Rarely occurs	N/A					
10. Exposure to hard edges	• Rarely occurs	N/A					
11. Hands and fingers exposed to cold temperatures	• Rarely occurs - handling of frozen goods is too low to be considered an exposure	N/A					

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Object is too far away	38. Move closer to the work location					
		• remove obstructions	✓		low	low	low
		• walk around the counter to handle items located in grocery carts	✓		low	low	low
		• use conveyor system to bring groceries	✓		low	low	low
	• Object must be lifted over bag's edge before lowered	150. Re-design work area					
		• place the bagging area directly beside the individual rather than off to one side	✓		low	low	med
		• lower the bag so that items are dropped into the bag rather than raising the item to clear the edge of the bag	✓		low	low	med
		13. Encourage ergonomic work techniques					
		• place the bag on its side when loading items into the bag rather than placing the bag in an upright position	✓		low	low	low
13. Twisting of the lower back	• Access is restricted to items that need to be handled	150. Re-design work area					
		• place the bagging area directly beside the individual rather than off to one side	✓		low	low	low
		• lower the bag so that items are dropped into the back rather than raising the item to clear the edge of the bag	✓		low	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
14. High speed, sudden movements, or lifting awkward, uneven, shifting or bulky items	• Person tends to lift with a jerky motion instead of a smooth motion	13. Encourage ergonomic work techniques • encourage person to use smooth fluid movements while handling items	✓		low	low	low
		11. Eliminate unnecessary tasks • implement an advanced checkout system that has clients bag their own items		✓	high	high	high
15. Static, awkward back postures	• Work positioned too low	124. Raise the work piece/work surface • raise cash counter or grocery counter so that the items are located just below elbow height		✓	high	med	med
16. Lifting forces	• Item is too heavy	142. Use two or more persons to perform the transfer	✓		low	low	low
		11. Eliminate unnecessary tasks • implement an advanced checkout system that has clients bag their own items		✓	low	low	low
		• Instruct customers to leave heavy items in basket and use a hand-held scanner	✓		low	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	• Rarely occurs	N/A					
18. Whole body vibration	• Rarely occurs	N/A					
19. Fixed position, standing	• Stands in one position	52. Provide a footrail or footrest • provide a footrest/footrail that allows the person to periodically raise one leg		✓	med	low	low

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
20. Exposure to hard edges on legs, knees, and feet <u>or</u> Standing on hard surfaces	• Stands on a hard surface	86. Provide an appropriate anti-fatigue mat • anti-fatigue matting should be large enough to accommodate movement of the person		✓	med	med	med
		96. Provide appropriate shoe inserts	✓		low to med	med	med
	• Leans against conveyor frame	9. Eliminate exposure to hard edges • provide high density foam padding		✓	med	low	low
21. Awkward leg postures	• Rarely occurs	N/A					
22. Awkward foot postures	• Lack of toe clearance	81. Provide adequate toe clearance		✓	med to high	low	med

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	N/A					
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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CASE STUDY - Baking

TASK TITLE: Baking

Task Description:	The Baking task involves the preparation of baked foods such as breads, cakes, pies and pastries. This includes moving boxes and bins of ingredients, mixing ingredients in large mixing bowls and moving pans to and from the ovens. Cooking (Food Preparation) and Cooking (Short-order Grill) are addressed in other case studies in this Guide. Typical examples in which the Baking tasks can occur include(but are not limited to) are: • Cafeterias and mess halls • Restaurants • Clubs
Job Performance Measures Most Often Impacted by Baking:	Measures of work performance can include (but are not necessarily limited to): • Hours daily to complete Baking tasks • Taste of food
Typical Employee Comments about Baking:	Employees typically experience discomfort in the legs/feet and lower back. They generally attribute this discomfort to a combination of standing on hard surfaces and lifting heavy bowls. The back/torso is the body area that most commonly receives a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	Dynamic Task Analysis, Biomechanical Lifting Analysis, Push/Pull Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Work area too high	32. Lower the work piece/work surface					
		• position ingredient prep work near or just above elbow level	✓		low	med	med
		• use an adjustable height table		✓	med	med	med
		• provide height adjustable mixing bowls		✓	med	med	med
		• provide several alternate work height prep tables		✓	med	med	med
		123. Raise the person					
		• provide a portable work platform which can be easily stored under the table, out of the way		✓	med to high	low	low
	• Items stored too high	123. Raise the person					
		• provide a footstool or small step	✓		low	low	low

Shoulder/Neck (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Items stored too high (cont'd)	32. Lower the work piece/work surface					
		• place frequently accessed and/or heavy ingredients on shelves between mid-thigh and chest height	✓		low	low	med
		13. Encourage ergonomic work techniques					
		• avoid stacking baking trays above shoulder height in cart racks	✓		low	low	low
	• Work too far away	41. Move work piece closer to body					
		• slide the work closer before lifting	✓		low	low	low
		149. Provide appropriate tools	✓		med	low	low
		• provide a rake-type tool to grasp containers					
	• Too many supplies on workstation	41. Move work piece closer to body					
		• place frequently used items with easy reach	✓		low	low	low
		• modify storage containers to reduce reach requirements		✓	med	med	med
		• provide dispensing mechanisms for ingredients		✓	med to high	med	med

Shoulder/Neck (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Reaching into oven to place/remove items in back	148. Provide appropriate equipment • install an oven with a vertical or horizontal rotisserie/carousel in order to minimize reaching and bending		✓	high	low	med
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Carrying stacks of pans and ingredient cases	48. Provide a cart • use existing carts • provide sufficient number of carts to insure availability	✓ 	 ✓	low med	low low	low med
		4. Change a lifting/carrying task into a rolling or sliding tasks • provide carts which can be adjusted to bench, shelf and oven heights to minimize lifting		✓	med	med	high
	• Rolling/sliding resistance of cart or piece of equipment causes high forces	35. Maintain tracks, rollers, and movement mechanisms • repair wheels on carts or equipment • install appropriate wheels; select larger wheels for the tile floors.	✓ ✓		med med	med med	med med
	• Freezer door is difficult to open	11. Eliminate unnecessary tasks • replace freezer door with an air curtain		✓	high	low	med

Shoulder/Neck (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	Level of Changes: ✓ Major Change	Cost	Impact On: Quality	Impact On: Productivity
	• Freezer door is difficult to open (continued)	35. Maintain tracks, rollers, and movement mechanisms					
		• perform routine lubrication and maintenance on the freezer door to limit force requirements	✓		med	low	med
		• lubricate door hinges	✓		low	low	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	med	med
		• repair cracks or gaps in floor	✓		high	med	med
		• provide ramps to compensate for minor differences in floor height		✓	med	med	med
3. High speed, sudden shoulder movements	• Speed of lift	13. Encourage ergonomic work techniques					
		• encourage person to use smooth fluid movements while handling items	✓		low	low	low
		128. Reduce force required to install or remove component					
		• approach vendor regarding means for reducing object weight		✓	med	med	med

Shoulder/Neck (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Freezer door is difficult to open	35. Maintain tracks, rollers, and movement mechanisms					
		• perform routine lubrication and maintenance on the freezer door to limit force requirements	✓		med	low	med
		• lubricate door hinges	✓		low	low	med
		11. Eliminate unnecessary tasks					
		• replace freezer door with an air curtain		✓	high	low	med
4. Head/neck bent or twisted	• Location of work too low	20. Incorporate rest pauses	✓		low	low	med
		124. Raise the work piece/work surface					
		• provide a riser or block to raise work surface	✓		low	high	high

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Hand manipulating dough and other ingredients 	149. Provide appropriate tools • use powered food mixers for as many tasks as possible	✓		med	low	med
		11. Eliminate unnecessary tasks • purchase ingredients already prepared and packaged to size		✓	med	low	med

Hands/Wrists/Arms (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
6. Repeated manipulations with fingers	• Hand manipulating dough and other ingredients	149. Provide appropriate tools • use powered food mixers for as many tasks as possible	✓		med	low	med
		11. Eliminate unnecessary tasks • purchase ingredients already prepared and packaged to size		✓	med	low	med
		20. Incorporate rest pauses	✓		low	low	low
7. Hyper-extension of finger/thumb or repeated single finger activation	• Cake decorating	149. Provide appropriate tools • use a dispenser that is triggered appropriately		✓	low	low	med
		20. Incorporate rest pauses	✓		low	low	low
		13. Encourage ergonomic work techniques • position hand to minimize holding the thumb or a finger away from the rest of the hand	✓		low	low	low
	• Using sifter	149. Provide appropriate tools • provide a tool that allows a comfortable hand position, particularly grip width.		✓	low to med	low	low

Hands/Wrists/Arms (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
8. Hand/grip forces	• Fingertip forces from prying apart pans that are stuck together	128. Reduce force required to install or remove component					
		• use a small wedge to separate pans	✓		low	low	med
		• use a spoon to perform the prying task	✓		low	low	med
	• Holding pans back too far on the handle	13. Encourage ergonomic work techniques					
		• choke up on handle to improve control of pan	✓		low	low	low
		94. Provide appropriate handles					
		• provide handles that are insulated to prevent contact with hot surfaces.		✓	med	med	med
	• Hand manipulating dough and other ingredients	149. Provide appropriate tools					
		• use powered food mixers for as many tasks as possible	✓		med	low	med
		11. Eliminate unnecessary tasks					
		• purchase ingredients already prepared and packaged to size		✓	med	low	med

Hands/Wrists/Arms (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Tearing open ingredient boxes and bags	13. Encourage ergonomic work techniques • use a knife to open boxes and bags	✓		low	med	med
		149. Provide appropriate tools • provide a utility razor to open boxes and bags	✓		low	med	med
10. Exposure to hard edges	• Hard edges from handing trays, pans and utensils	93. Provide appropriate gloves	✓		med	low	low
		9. Eliminate exposure to hard edges • use pot holders to avoid exposure to hard edges	✓		low	low	low
11. Hands and fingers exposed to cold temperatures	• Working in freezers, working with cold ingredients	93. Provide appropriate gloves • provide insulated gloves covered by an outer layer of plastic		✓	med	low	low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Oven heights, mixer bowl heights and storage heights too low	13. Encourage ergonomic work techniques					
		• use oven rack heights between mid-thigh and mid-chest height whenever possible	✓		low	low	low
		124. Raise the work piece/work surface					
		• place frequently accessed and/or heavy ingredients on shelves between mid-thigh and chest height	✓		low	low	low
		• provide a small portable lift cart that will allow the mixer bowl to be lifted to table height		✓	med	low	low
		148. Provide appropriate equipment					
		• install an oven with a vertical or horizontal rotisserie/carousel in order to minimize reaching and bending		✓	high	low	med

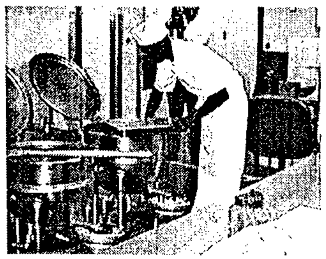
Back/Torso (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Stacking items on low shelves of cart causes awkward bending	13. Encourage ergonomic work techniques					
		• use cart shelves between knee and shoulder heights whenever possible	✓		low	low	low
		48. Provide a cart					
		• provide a cart that has spring loaded shelves (e.g., dish cart) or use a cart which has the bottom shelf removed		✓	med	med	med
	• Person tends to use the back to lift instead of using the legs to assist in the lift (check for contributing factor in the workplace)	13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use leg muscles to lift	✓		low	low	low
		48. Provide a cart					
		• provide a cart that has spring loaded shelves (e.g., dish cart) or use a cart which has the bottom shelf removed		✓	med	med	med

Back/Torso (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
13. Twisting of the lower back	• Work area layout	130. Reduce the angle a person has to turn to transfer an item					
		• for example, if the transfer involves a 180 degree twist, move the source or destination to reduce the twist to 90 degrees or less	✓		low to high	low	med
		• reposition supplies/materials to reduce twisting	✓		low to high	low	med
		13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use legs to pivot when handling a load	✓		low	low	low
14. High speed, sudden movements <u>or</u> Lifting awkward, uneven, shifting or bulky items.	• Person tends to lift with a jerky motion instead of a smooth motion	13. Encourage ergonomic work techniques					
		• encourage person to use smooth fluid movements while handling items	✓		low	low	low
		128. Reduce force required to install or remove component	✓		low	low	med
		147. Provide an alternate container					
		• contact vendor to request addition of handles or repackaging of contents to increase density		✓	med	med	med

Back/Torso (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
15. Static, awkward back postures	• Bending over scooping ingredients from mixer bowl 	124. Raise the work piece/work surface • provide a small portable lift cart that will allow the mixer bowl to be lifted to table height		✓	med	med	med
16. Lifting forces	• Lifting full pans from the oven. Lifting ingredients from shelves. Lifting mixing bowls.	4. Change a lifting/carrying task into a rolling or sliding task • provide adjustable height carts which adjust to bench, shelf and oven heights to minimize lifting		✓	med	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Lifting full pans from the oven. Lifting ingredients from shelves. Lifting mixing bowls. (continued)	13. Encourage ergonomic work techniques • encourage person to keep load as close to body as possible	✓		high	med	med
		11. Eliminate unnecessary tasks • investigate bulk delivery of flour and other supplies		✓	high	med	med
		124. Raise the work piece/work surface • provide a small portable lift cart that will allow the mixer bowl to be lifted to table height		✓	med	med	med
17. Pushing or pulling	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition • repair wheels on carts or equipment		✓	med	med	med
		119. Provide wheels • provide wheels with appropriate bearings and tread composition		✓	med	med	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	high	high
		• repair cracks or gaps in floor	✓		high	med	med
		• provide ramps to compensate for minor differences in floor height		✓	med	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	Level of Changes: ✓ Major Change	Cost	Impact On: Quality	Impact On: Productivity
	• Freezer door is difficult to open	11. Eliminate unnecessary tasks • replace freezer door with an air curtain		✓	high	low	med
		35. Maintain tracks, rollers, and movement mechanisms • perform routine lubrication and maintenance on the freezer door to limit force requirements	✓		med	low	med
		• lubricate door hinges	✓		low	low	med
18. Whole body vibration	• Rarely occurs	N/A					
19. Fixed position, standing	• Prolonged standing	52. Provide a footrail or footrest • provide a footrest/footrail that allows the person to periodically raise one leg		✓	low to med	low	med
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Standing on a hard surface	86. Provide an appropriate anti-fatigue mat		✓	med	low	med
		96. Provide appropriate shoe inserts		✓	med	low	med
21. Awkward leg postures	• Rarely occurs	N/A					
22. Awkward foot postures	• Rarely occurs	N/A					

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high		18. Improve visual access to work • Light levels should be 75fc to 125fc for work		✓	low	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Cake decorating	20. Incorporate rest pauses	✓		low	low	low

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CASE STUDY – Commissary/Meat Cutting	
TASK TITLE: Commissary/Meat Cutting	
Task Description:	The Commissary/Meat Cutting task may be involved when working in a deli, meat-cutting counter or small meat processing facility within a commissary. Cutting methods can involve both automated equipment and manual meat cutting with a knife Typical jobs in which the Commissary/Meat Cutting task occurs can include (but are not necessarily limited to): • Commissary Deli • Commissary Meat Cutting • Restaurant
Job Performance Measures Most Often Impacted by Commissary/Meat Cutting:	Measures of work performance can include (but are not necessarily limited to): • Type of cut • Quality of cut • Number of cuts
Typical Employee Comments about Commissary/Meat Cutting:	Employees typically experience discomfort in the hand/wrists/arms, legs/feet, and back. The shoulders/neck and hands/wrists/arms are the body areas that most commonly receive a "High" priority rating. The remaining areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	NIOSH Lifting Equation, Biomechanical Lifting Analysis, Push/Pull Force Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Meat placed too far from person 	41. Move work piece closer to body • place the meat near the edge of the cutting table when cutting	✓		low	low	low
		149. Provide appropriate tool • use a hook type tool to pull meat closer when handing meat from one person to another person during processing	✓		high	low	low
	• Repetitive sawing tasks	11. Eliminate unnecessary tasks • install a riser on the front sliding surface of saw. This will raise the meat higher and make use of gravity to drop the meat into a collection tray. This would eliminate a repetitive throwing task and reduce the chance of severe cuts from the saw blade	✓		low to med	high	high

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	Level of Changes: ✓ Major Change	Cost	Impact On: Quality	Impact On: Productivity
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Meat box is too heavy 	48. Provide a cart • when moving boxes of meat place the box on a cart		✓	high	med	med
		13. Encourage ergonomic work techniques • move around the pallet rather than reach over the pallet to reach and lift boxes of meat	✓		low	low	low
	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition • repair wheels on carts or equipment	✓		low	low	low
		119. Provide wheels • install appropriate wheels		✓	high	med	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	low	low
		• repair cracks or gaps in floor	✓		med	low	low
		• provide ramps to compensate for minor differences in floor height		✓	high	med	med
	• Meat is difficult to cut	137. Sharpen blades frequently • encourage person to frequently sharpen knife while cutting	✓		low	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	Level of Changes: ✓ Major Change	Cost	Impact On: Quality	Impact On: Productivity
3. High speed, sudden shoulder movements	• Speed of lifting boxes of meat	48. Provide a cart • store meat on a height adjustable cart		✓	med	med	med
		13. Encourage ergonomic work techniques • encourage person to use smooth, fluid movements while handling items	✓		low	low	low
	• Repetitive sawing tasks 	11. Eliminate unnecessary tasks • install a riser on the front sliding surface of saw. This will raise the meat higher and make use of gravity to drop the meat into a collection tray. This would eliminate a repetitive throwing task.	✓		low to med	high	high
		25. Increase task variety	✓		low	low	low
		137. Sharpen blades frequently • encourage person to frequently sharpen knife while cutting	✓		low	low	low
4. Head/neck bent or twisted	• Work is positioned too low	20. Incorporate rest pauses	✓		low	low	low
		25. Increase task variety	✓		low	low	low
		83. Provide an adjustable height lift table • provide a small stand to raise and tilt the work toward the person	✓		low to med	low	low

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Location of the work and angle of the cut causes awkward wrist postures 	66. Provide power tool • provide a powered knife for repetitive cutting tasks		✓	high	med	med
		77. Provide a tool with an appropriate handle angle • for straight horizontal cutting, use a knife with a vertical handle that encourages a neutral wrist position	✓		med	med	med
		25. Increase task variety • alternate meat-cutting tasks – move from a manual cutting task to more automated meat cutting on the saws or packing lines	✓		low	low	low
		137. Sharpen blades frequently • ensure knife is regularly sharpened while cutting	✓		Low	Med	Med
		136. Rotate the work • turn the meat while cutting to position the meat in a location that prevents awkward wrist postures	✓		low	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Repetitive sawing tasks	11. Eliminate unnecessary tasks • install a riser on the front sliding surface of saw. This will raise the meat higher and make use of gravity to drop the meat into a collection tray. This would eliminate a repetitive throwing task	✓		low to med	high	high
		25. Increase task variety	✓		low	low	low
		137. Sharpen blades frequently • encourage person to frequently sharpen knife while cutting	✓		low	low	low
6. Repeated manipulations with fingers	• Repetitive sawing tasks	11. Eliminate unnecessary tasks • install a riser on the front sliding surface of saw. This will raise the meat higher and make use of gravity to drop the meat into a collection tray. This would eliminate a repetitive throwing task	✓		low to med	high	high
		25. Increase task variety	✓		low	low	low
		137. Sharpen blades frequently • encourage person to frequently sharpen knife while cutting	✓		low	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
7 Hyper-extension of finger/thumb or repeated single finger activation	• Work technique	66. Provide power tool					
		• provide a powered knife for repetitive cutting tasks		✓	high	med	med
		13. Encourage ergonomic work techniques					
		• hold fingers close together	✓		low	low	low
		• avoid extending fingers while cutting, such as placing thumb along top of knife	✓		low	low	low
8. Hand/grip forces	• Meat is difficult to cut	137. Sharpen blades frequently					
		• encourage the person to regularly sharpen knife while cutting	✓		low	low	low
	• Handle is slippery	54. Provide a high friction gripping surface					
		• provide a knife with a surface that improves gripping	✓		med	med	low
		• consider cutting on stainless steel surfaces		✓	med	med	med
	• Gloves are bulky and do not properly fit	93. Provide appropriate gloves					
		• use gloves that fit properly and allow for full movement of the hand	✓		low	low	low
		• use gloves that provide a textured surface for improved grip		✓	low	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Use of a power knife that is poorly maintained	34. Maintain hand tool/power tools • ensure powered knife is well maintained	✓		low	med	med
		137. Sharpen blades frequently	✓		low	med	med
	• Repetitive sawing or slicing tasks	11. Eliminate unnecessary tasks • install a riser on the front sliding surface of saw. This will raise the meat higher and make use of gravity to drop the meat into a collection tray. This would eliminate a repetitive throwing task	✓		low to med	high	high
		25. Increase task variety	✓		low	low	low
		137. Sharpen blades frequently • encourage person to frequently sharpen blades while cutting	✓		low	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
10. Exposure to hard edges	• Hook has a small handle or hard edges on the handle	149. Provide appropriate tools • provide a D handle instead of a T handle • increase handle diameter to 1-1½" (2.5-2.8cm)		✓ ✓	med low to med	low low	low low
11. Hands and fingers exposed to cold temperatures	• Work area is too cold	93. Provide appropriate gloves • use gloves that fit properly, do not restrict movement of the hand, and use a textured surface for improved grip • provide gloves which insulate hands and provide a moisture barrier	✓ ✓		low low	low low	low low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Object is too low	124. Raise the work piece/work surface					
		• place boxes of meat on pallets to raise the boxes off the floor surface	✓		low	low	low
		• place pallet of boxes on a height adjustable scissor lift		✓	high	med	med
		• ensure heavy items are placed between knee and waist height for easy handling	✓		low	low	low
	• Object is too far away	41. Move work piece closer to body					
		• pull meat to edge of table	✓		low	low	low
		12. Provide adequate workspace					
		• ensure space is provided around all four sides of the pallet so that the individual can move in close enough to the item stored on the pallet	✓		low	low	low
	• There is no place to store the case of meat at the workstation	24. Increase size of work surface					
		• rearrange work station to provide additional storage space	✓		low	med	med
		• provide larger work surface area		✓	med	med	med
		124. Raise the work piece/work surface					
		• place meat at a table	✓		low to med	med	med
		48. Provide a cart					
		• store meat on an adjustable cart		✓	med	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes ✓ Minor Modification	✓ Major Change	Cost	Impact On: Quality	Productivity
	• Person tends to use the back to lift instead of using the legs to assist in the lift. Check to make sure that there is no contributing factor in the workplace.	130. Reduce angle a person turns to transfer items					
		• place adjacent work surfaces at 90 degrees to one another		✓	med	med	med
		48. Provide a cart					
		• provide a cart with height adjustable shelves		✓	med	med	med
		13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use leg muscles to lift	✓		low	low	low
13. Twisting of the lower back	• Person tends to twist with the back instead of using the legs and feet to pivot	130. Reduce angle a person turns to transfer items					
		• place adjacent work surfaces at 90 degrees to one another		✓	med	med	med
		13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓	low	low	low	low
		• encourage person to use legs to pivot when handling a load	✓	low	low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
14. High speed, sudden movements or Lifting awkward, uneven, shifting or bulky items	• Lifting cases of meat	4. Change a lifting/carrying task into a rolling or sliding task • provide a height adjustable cart for transporting cases of meat		✓	med	med	med
	• Box or meat is frozen to storage surface making it difficult to move	128. Reduce force required to install or remove component • Put a covering on the shelves to reduce friction	✓		low	med	med
		11. Eliminate unnecessary tasks • place meat in containers to eliminate removal directly from shelves	✓		low	med	med
		149. Provide appropriate tools • provide a wedge or prybar that can be used to pry frozen boxes of meat apart	✓		med	low	low
	• Person tends to lift with a jerky motion instead of a smooth motion	61. Provide a mechanical lifting aid • provide a vacu-hoist or other means of mechanical assistance to move objects		✓	med	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Person tends to lift with a jerky motion instead of a smooth motion (continued)	13. Encourage ergonomic work techniques • encourage person to use smooth, fluid movements while handling items	✓		low	low	low
	• Loading hamburger into processing equipment	30. Provide a mechanical lifting aid • provide a mechanical dumping device to load hamburger		✓	med	low	low
15. Static, awkward back postures	• Work location too low 	124. Raise the work piece/work surface • raise the worktable to encourage more neutral positions of the back. The task location should be just below elbow height for light cutting, and approximately 2-4"(5.1-10.2cm) below elbow height for heavy cutting of cold meat		✓	high	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
16. Lifting forces	• Lifting cases of meat 	4. Change a lifting/carrying task into a rolling or sliding task • provide a height adjustable cart for transporting cases of meat		✓	med	med	med
		20. Incorporate rest pauses	✓		low	low	low
	• Loading hamburger into processing equipment	61. Provide a mechanical lift device • provide a mechanical dumping device to load hamburger		✓	med	low	low
		131. Reduce weight of work piece (boxes of meat) • avoid over-packing trays of wrapped meat	✓		low	low	low
		• investigate the feasibility of ordering meat in smaller box sizes		✓	low	low	low
		142. Use two or more persons to perform the transfer	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	• Rolling/sliding resistance of car or piece of equipment causes high forces	119. Provide wheels • provide wheels with appropriate bearings and tread composition	✓		low	low	low
		19. Improve wheel condition • repair wheels on carts or equipment	✓		low	low	low
	• Cart or piece of equipment is too heavy to be pushed manually	67. Provide a powered cart • provide motorized assistance to transport cart or piece of equipment		✓	high	med	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition • improve housekeeping • repair cracks or gaps in floor • provide ramps to compensate for minor differences in floor height	✓ ✓ 	 ✓	low low high	low low med	low med med
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes ✓ Minor Modification	✓ Major Change	Cost	Impact On: Quality	Productivity
19. Fixed position, standing	• Worker stands in one position	52. Provide a footrest or footrail • provide a footrail or footrest under the work surface so the individual can elevate one leg while standing, encouraging a more neutral position of the back	✓	✓	med	med	med
		96. Provide appropriate shoe inserts	✓		low	low	low
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Prolong standing	86. Provide an appropriate anti-fatigue mat		✓	med	med	med
	• Leans into edge of table 	9. Eliminate exposure to hard edges • redesign or round the front edge of worksurface	✓		low to med	low	med

Legs/Feet(cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
21. Awkward leg postures	• Inadequate legroom under the surface restricts leg position	80. Provide adequate leg clearance	✓		low	low	low
22. Awkward foot postures	• Operates a foot pedal while standing	145. Modify foot pedal • recess foot pedal into floor surface • provide a foot pedal that is a low profile design, reducing the need to flex the ankle		✓ ✓	high med to high	low med	med med

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	18. Increase visual access to work • light levels should be 100-175 fc for work		✓	low to med	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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CASE STUDY – Cooking (Food Preparation)	
TASK TITLE: Cooking (Food Preparation)	
Task Description:	The Cooking (Food Preparation) task involves all aspects of the preparation of foods. This includes moving boxes and bins of ingredients, cutting ingredients into pieces, as well as moving pans to and from the ovens. Short order grill cooking and preparing baked goods are addressed in the Cooking (Short Order Grill) and Baking case studies, respectively. Typical environments in which the Cooking (Food Preparation) tasks can occur include (but are not limited to) are: • Cafeterias and mess halls • Restaurants • Clubs
Job Performance Measures Most Often Impacted by Cooking: (Food Preparation)	Measure of work performance can include (but are not necessarily limited to): • Hours daily to complete Cooking (Food Preparation) tasks • Taste of food
Typical Employee Comments about Cooking: (Food Preparation0	Employees typically experience discomfort in the legs/feet and lower back. The back/torso is the body area that most commonly receives a “High” priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a “Medium” priority rating, or lower.
Suggested Level II Analysis:	Dynamic Task Analysis, Biomechanical Lifting Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Work area too high 	32. Lower the work piece/work surface					
		• position ingredient prep work near or just above elbow level	✓		low	med	med
		• use an adjustable height table		✓	med	med	med
		• provide height adjustable mixing bowls		✓	med	med	med
		• provide several alternate work height prep tables		✓	med	med	med
		123. Raise the person					
		• provide a portable work platform which can be easily stored under the table, out of the way		✓	med to high	low	low
	• Items stored too high	123. Raise the person					
		• provide a footstool or small step	✓		low	low	low
		32. Lower the work piece/work surface					
		• place frequently accessed and/or heavy ingredients on shelves between mid-thigh and chest height	✓		low	low	med
		13. Encourage ergonomic work techniques					
		• avoid stacking pans above shoulder height in cart racks	✓		low	low	low
		• place frequently accessed and/or heavy ingredients on shelves between mid-thigh and chest height	✓		low	low	low

Shoulder/Neck (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Work too far away	41. Move work piece closer to body					
		• place frequently used items with easy reach	✓		low	low	low
		• modify storage containers to reduce reach requirements		✓	med	med	med
		• provide dispensing mechanisms for ingredients		✓	med to high	med	med
		13. Encourage ergonomic work techniques					
		• slide the work closer before lifting	✓		low	med	low
		• use front stove burners for foods requiring considerable attention during cooking	✓		low	med	low
	• Reaching into oven to place/remove items in back	148. Provide appropriate equipment					
		• install an oven with a vertical or horizontal rotisserie/carousel in order to minimize reaching and bending		✓	high	low	med

Shoulder/Neck (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Carrying stacks of pans and ingredient cases more than three steps	48. Provide a cart					
		• use existing carts	✓		low	low	low
		• provide sufficient number of carts to insure availability		✓	med	low	med
		4. Change a lifting/carrying task to a rolling or sliding tasks					
		• provide carts which can be adjusted to bench, shelf and oven heights to minimize lifting		✓	med	med	high
		126. Reduce carry distance					
		• arrange storage and work areas to reduce travel distances	✓		low	med	high
		11. Eliminate unnecessary tasks					
		• eliminate or combine handling tasks	✓		low to high	med	high
		• transport items in larger quantities instead of handling them individually	✓		low to high	med	high
	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition					
		• repair wheels on carts or equipment	✓		med	high	high
		119. Provide wheels					
		• install appropriate wheels; select larger wheels for the tile floors.	✓		med	high	high

Shoulder/Neck (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	med	med
		• repair cracks or gaps in floor		✓	high	med	med
		• provide ramps to compensate for minor differences in floor height		✓	med	med	med
	• Reaching into oven to place/remove items in back	148. Provide appropriate equipment					
		• install an oven with a vertical or horizontal rotisserie/carousel in order to minimize reaching and bending		✓	high	low	med
	• Freezer door is difficult to open	35. Maintain tracks, rollers, and movement mechanisms					
		• perform routine lubrication and maintenance on the freezer door to limit force requirements	✓		med	low	med
		• lubricate door hinges	✓		low	low	med
		11. Eliminate unnecessary tasks					
		• replace freezer door with an air curtain		✓	high	low	med

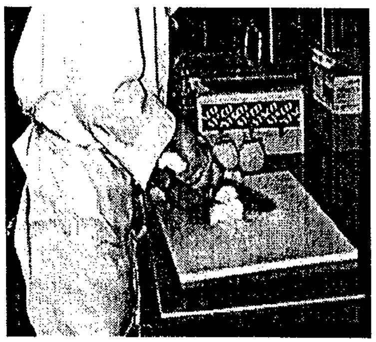
Shoulder/Neck (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements	• Speed of lift	13. Encourage ergonomic work techniques • encourage person to use smooth fluid movements while handling items	✓		low		low
		147. Provide alternate container • contact vendor to request addition of handles or repackaging of contents to increase density		✓	med	med	med
	• Freezer door is difficult to open	35. Maintain tracks, rollers, and movement mechanisms • perform routine lubrication and maintenance on the freezer door to limit force requirements	✓		med	low	med
		• lubricate door hinges	✓		low	low	med
		11. Eliminate unnecessary tasks • replace freezer door with an air curtain		✓	high	low	med

Shoulder/Neck (Cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
4. Head/neck bent or twisted	• Location of work too low 	20. Incorporate rest pauses	✓		low	low	med
		124. Raise the work piece/work surface • provide a riser or block to raise work surface	✓		low	high	high

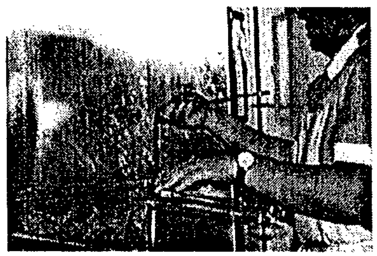
Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes ✓ Minor Modification	✓ Major Change	Cost	Impact On Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Cutting ingredients with knife 	149. Provide appropriate tools					
		• a bent handle knife can be appropriate for many slicing and chopping tasks		✓	med	low	low
		• use a food processor to chop ingredients		✓	med	low	med
	• Repeated movements from stirring or scraping kettles clean	13. Encourage ergonomic work techniques					
		• use cooking sprays during cooking	✓		low	low	med
		• soak kettles immediately after use	✓		low	low	med
		148. Provide appropriate equipment					
		• provide kettles and other cooking equipment that have non-stick surfaces		✓	med	low	med
		• provide automatic stirring elements or powered mixers for mixing tasks		✓	med	low	med

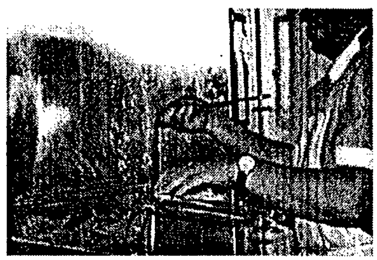
Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
6. Repeated manipulations with fingers	• Hand manipulating ingredients	149. Provide appropriate tools • use powered food mixers for as many tasks as possible	✓		med	low	med
		13. Encourage ergonomic work techniques • encourage personnel to minimize awkward wrist postures	✓		low	low	low
7. Hyper-extension of finger/thumb or repeated single finger activation	• Rarely occurs						
8. Hand/grip forces	• Fingertip forces used to pry apart pans that are stuck together	128. Reduce force required to install or remove component • use a small wedge to separate pans	✓		low	low	med
		• a spoon or small pry bar can be used to perform the prying task	✓		low	low	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Holding pans with a pinch grip 	3. Change a pinch grip to a power grip • use a full hand grip on pans when possible	✓		low	low	low
	• Holding pans back too far on the handle	13. Encourage ergonomic work techniques • choke up on handle to improve control of pan	✓		low	low	low
		94. Provide appropriate handles • provide handles that are insulated to prevent contact with hot surfaces.		✓	med	med	med
	• Hand manipulating ingredients	149. Provide appropriate tools • use powered food mixers for as many tasks as possible	✓		med	low	med
		13. Encourage ergonomic work techniques • encourage personnel to minimize awkward wrist postures	✓		low	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Tearing open ingredient boxes and bags	13. Encourage ergonomic work techniques • use a knife to open boxes and bags	✓		low	med	med
		149. Provide appropriate tools • provide a utility razor to open boxes and bags	✓		low	med	med
10. Exposure to hard edges	• Hard edges on trays, pans and utensils 	93. Provide appropriate gloves	✓		med	low	low
		9. Eliminate exposure to hard edges • use pot holders to avoid exposure to hard edges	✓		low	low	low
11. Hands and fingers exposed to cold temperatures	• Working in freezers, working with cold ingredients	93. Provide appropriate gloves • provide insulated gloves covered by an outer layer of plastic		✓	med	low	low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Oven heights, stove heights and storage heights too low 	4. Change a lifting/carrying task into a rolling or sliding tasks • provide adjustable height carts which can adjust to bench, shelf and oven heights to minimize lifting		✓	med	med	med
		13. Encourage ergonomic work technique • use oven rack heights between mid-thigh and mid-chest height whenever possible	✓		low	low	low
		124. Raise the work piece work/surface • place frequently accessed and/or heavy ingredients on shelves between mid-thigh and chest height	✓		low	low	low
	• Stacking items on low shelves of cart causes awkward bending	13. Encourage ergonomic work technique • place frequently accessed and/or heavy ingredients on shelves between mid-thigh and chest height	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Stacking items on low shelves of cart causes awkward bending	48. Provide a cart					
		• provide a cart that has spring loaded shelves (e.g., dish cart) or use a cart which has the bottom shelf removed	✓		med	med	med
	• Person tends to use the back to lift instead of using the legs to assist in the lift. Check for contributing factors in the workplace	13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		med	med	med
		• encourage person to use leg muscles to lift	✓		med	med	med
	• Reaching into oven to place/remove items in back	148. Provide appropriate equipment					
		• install an oven with a vertical or horizontal rotisserie/carousel in order to minimize reaching and bending		✓	high	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
13. Twisting of the lower back	• Work area layout • Person tends to twist with the back instead of using the legs and feet to pivot	130. Reduce the angle a person has to turn to transfer an item					
		• for example, if the transfer involves a 180 degree twist, move the source or destination to reduce the twist to 90 degrees or less	✓		low to high	low	med
		• reposition supplies/materials to reduce twisting	✓		low to high	low	med
		13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use legs to pivot when handling a load	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
14. High speed, sudden movements or Lifting awkward, uneven, shifting or bulky items.	• Person tends to lift with a jerky motion instead of a smooth motion	147. Provide alternate container • contact vendor to request addition of handles or repackaging of contents to increase density		✓	med	med	med
		13. Encourage ergonomic work techniques • encourage person to use smooth fluid movements while handling items	✓		low	low	low
15. Static, awkward back postures	• Ingredient prep area too low	83. Provide an adjustable height lift table • position ingredient prep work near or just above elbow level	✓	✓	low to med	med	med
		• provide adjustable height table for ingredient preparation		✓	high	med	med
		• provide several alternate work heights		✓	med	med	med
16. Lifting forces	• Lifting full pans from the oven. • Lifting ingredients from shelves.	4. Change a lifting/carrying task into a rolling or sliding task • provide adjustable height carts which adjust to bench, shelf and oven heights to minimize lifting		✓	med	med	med
		13. Encourage ergonomic work techniques • encourage person to keep load as close to body as possible	✓		low	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition					
		• repair wheels on carts or equipment		✓	med	med	med
		119. Provide wheels					
		• provide wheels with appropriate bearings and tread composition		✓	med	med	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	high	high
		• repair cracks or gaps in floor	✓		high	med	med
		• provide ramps to compensate for minor differences in floor height		✓	med	med	med
	• Freezer door is difficult to open	35. Maintain tracks, rollers, and movement mechanisms					
		• perform routine lubrication and maintenance on the freezer door to limit force requirements	✓		med	low	med
		• lubricate door hinges	✓		low	low	med
		11. Eliminate unnecessary tasks					
		• replace freezer door with an air curtain		✓	high	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
18. Whole body vibration	• Rarely occurs	N/A					
19. Fixed position, standing	• Prolonged standing 	52. Provide a footrail or footrest		✓	low to med	low	med

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
20. Exposure to hard edges on legs, knees, and feet <u>or</u> Standing on hard surfaces	• Standing on a hard surface	86. Provide an appropriate anti-fatigue mat		✓	med	low	med
		96. Provide appropriate shoe inserts	✓		low	low	med
21. Awkward leg postures	• Rarely occurs	N/A					
22. Awkward foot postures	• Rarely occurs	N/A					

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	18. Improve visual access to work • Light levels should be 50fc to 100fc for work		✓	low to high	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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CASE STUDY – Cooking (Short Order Grill)

TASK TITLE: Cooking (Short Order Grill)

Task Description:	The Cooking (Short Order Grill) task occurs in a cafeteria-style environment. In this work situation, the employee uses two primary work surfaces; the food preparation counter and the grill. These work surfaces are usually opposite each other and the employee turns or pivots 180 degrees between the two as needed. Food orders are given to the employee verbally or on order slips that are hung above the food preparation counter. The food/supplies/plates are typically stored under, over and/or to the sides of the grill and food preparation counters. The tools most commonly used include spatulas, knives, brushes, and a scraper for cleaning the grill surface. Typical environments in which the Cooking (Short Order Grill) task occurs can include (but are not necessarily limited to): • Cafeteria • Dining hall
Job Performance Measures Most Often Impacted by Cooking (Short Order Grill):	Measures of work performance can include (but are not necessarily limited to): • Speed of service/waiting time for order • Quality of food serving/presentation.
Typical Employee Comments about Cooking (Short Order Grill):	Employees typically experience discomfort in the back, shoulders and wrists. The back/torso and shoulders/neck are the body areas that most commonly receive a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	Elemental Task Analysis, Dynamic Task Analysis, Biomechanical Lifting Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Food order slips are too high and/or too far away • Plates and other frequently used items are too high above the work surface	32. Lower the work piece/work surface					
		• clip the order slips on a lazy susan which is no higher than 50 inches (127 cm) above the floor		✓	med	low	low
		• store plates inside a portable spring loaded plate dispenser (as often is used at the beginning of a buffet)		✓	high	low	low
	• Storage shelves are too deep • Grill is too large/too deep • Cooking on the rear of the grill	38. Move closer to the work location					
		• avoid using the rear areas of shelves except for infrequently used items; store plates on the forward edge of shelves	✓		low	low	med
		• encourage the employee to avoid using the rear area of the grill whenever possible	✓		low	low	low
		24. Increase size of work surface					
		• provide a wide grill surface no deeper than 30 inches (76 cm)		✓	high	low	low
	• The scraper tool handle is too short	149. Provide appropriate tools					
		• Provide tools with appropriate handle diameters and lengths	✓		low	low	low
		• lengthen the scraper tool handle to prevent reaching when scrapping the rear areas of the grill (make long enough to use two hands, providing leverage)	✓		low	low	low

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	Level of Changes: ✓ Major Change	Cost	Impact On: Quality	Impact On: Productivity
	• Surface (sill) for placement of finished order is too far away	38. Move closer to the work location • relocate the food preparation table to provide direct access to the sill	✓		low	low	low
		41. Move work piece closer to body • if the food preparation table must be located under the sill, decrease the depth of the table	✓		med	low	low
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Prolonged holding of plate while serving	11. Eliminate unnecessary tasks • do not hold plate; place plate on grill's side while placing food	✓		low	low	low
	• Scraping of grill can require excessive force	137. Sharpen blades frequently • keep scraper tool blade sharp	✓		low	low	low
		149. Provide appropriate tools • provide tools with appropriate handle diameters and lengths	✓		low	low	low
		• lengthen the scraper tool handle to prevent reaching when scraping the rear areas of the grill (make long enough to use two hands, providing leverage)		✓	med	low	med
		11. Eliminate unnecessary tasks • encourage the employee to squirt water (with a squirt bottle or sprayer) on grill to "deglaze" prior to scraping; food residue can then be wiped from the grill	✓		low	low	low

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements	• Rarely occurs	N/A					
4. Head/neck bent or twisted	• Food order slips are too high; employee must look up to read	32. Lower the work piece/work surface • clip the order slips on a lazy susan which is no higher than 50" (127 cm) above the floor		✓	med	low	low
	• Grill too low 	124. Raise the work piece/work surface • consider raising the grill to slightly above elbow height (40"-45") (102-114 cm)		✓	med to high	med	med

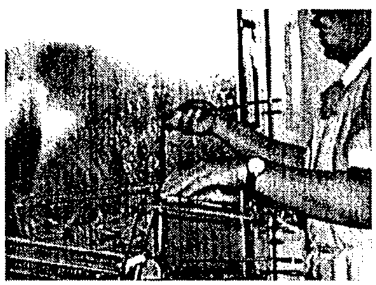
Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/ repeated wrist movements or repeated forearm rotation	• Repeated or excessive use of spatulas for flipping meat patties or other food items 	11. Eliminate unnecessary tasks • install grill press which cooks meat patties/grilled sandwiches on both sides simultaneously		✓	high	low	med
		13. Encourage ergonomic work techniques • alternate hands whenever possible • insert spatula under meat patty from the side and flip in a single motion	✓ ✓		low low	low low	low low
	• Spreading of dressing or butter on bread using knife or spatula	148. Provide appropriate equipment • spread melted butter and other soft food products with brushes	✓		low	low	low
	• repeated manual cutting tasks (e.g., slicing/dicing vegetables)	66. Provide a power tool • provide a food processor		✓	med	med	med
		• slice/dice frequently used items in small batches	✓		low	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Excessive use of aerosol spray oil	149. Provide appropriate tools • spread a light coating of oil using a brush	✓		low	low	low
8. Hand/grip forces	• Scraping of grill can require excessive force	137. Sharpen blades frequently • keep scraper tool sharp	✓		low	low	low
		149. Provide appropriate tools • provide tools with appropriate handle diameters and lengths	✓		low	low	low
		• lengthen the scraper tool handle to prevent reaching when scraping the rear areas of the grill (make long enough to use two hands, providing leverage)	✓		low	low	med
		11. Eliminate unnecessary tasks • encourage the employee to squirt water (with a squirt bottle or sprayer) on grill to "deglaze" prior to scraping; food residue can then be wiped from the grill	✓		low	low	low
	• Cooking tools require pinch grips	94. Provide appropriate handles • provide cooking tools with larger grips	✓		low	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Rarely occurs	N/A					
10. Exposure to hard edges	• Tool has sharp edges 	93. Provide appropriate gloves 9. Eliminate exposure to hard edges • use pot holders to avoid exposure to hard edges	✓ ✓		med low	low low	low low
11. Hands and fingers exposed to cold temperatures	• Handling of frozen foods is a low frequency task and would not be considered a problem	N/A					

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Food order slips are too far away	32. Lower the work piece/work surface • clip the order slips on a lazy susan which is no higher than 50 inches (127 cm) above the floor and no further away than 30 inches (76 cm)		✓	med	low	low
	• Plates are stored too low	124. Raise the work piece/work surface • store plates inside a portable spring loaded plate dispenser (as is often used at a buffet)		✓	high	low	low
	• Storage shelves are too deep • Grill is too large/too deep • Cooking on the rear of the grill	41. Move work piece closer to body • avoid using the rear areas of shelves except for infrequently used items; store plates on the forward edge of shelves	✓		low	low	low
		• encourage the employee to avoid using the rear area of the grill whenever possible	✓		low	low	med
		24. Increase size of work surface • provide a wide grill surface no deeper than 30 inches (76 cm)		✓	low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• The scraper tool handle is too short 	149. Provide appropriate tools					
		• provide tools with appropriate handle diameters and lengths	✓		low	low	low
		• lengthen the scraper tool handle to prevent reaching when scrapping the rear areas of the grill (make long enough to use two hands, providing leverage	✓		low	low	med
	• Surface (sill) for placement of finished order is too far away	38. Move closer to the work location					
		• relocate the food preparation table to provide direct access to the sill	✓		low	low	med
		41. Move work piece closer to body					
		• if the food preparation table must be located under sill, decrease the depth of the table		✓	med	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	Level of Changes: ✓ Major Change	Cost	Impact On: Quality	Impact On: Productivity
13. Twisting of the lower back	• Person tends to twist with the back instead of moving the entire body	150. Re-design work space • Re-design work space so that adjacent work surfaces are at right angles to each other or are placed so that the aisle between is not greater than 42 inches		✓	high	low	med
		67. Provide a powered cart • Provide a cart with swiveling casters to hold and move food products between work surfaces.		✓	high	low	med
		13. Encourage ergonomic work techniques • provide training on ergonomics principles and proper body mechanics	✓		low	low	low
		• encourage person to move the feet instead of reaching/twisting between the two work surfaces	✓		low	low	low
14. High speed, sudden movements **or** Lifting awkward, uneven, shifting or bulky items.	• Person tends to lift with a jerky motion instead of a smooth motion	147. Provide an alternate container • approach vendor to request packaging that is easier to handle		✓	low to high	low	med
		13. Encourage ergonomic work techniques • use slow controlled movements	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
15. Static, awkward back postures	• Prolonged leaning over the work surface	124. Raise the work piece/work surface					
		• place the grill on blocks/increase height	✓		low	low	low
		• raise the food preparation table on blocks	✓		low	low	low
		• install adjustable height legs to the food preparation table		✓	med	low	low
		13. Encourage ergonomic work techniques					
		• encourage the person to stand up straight periodically during the job	✓		low	low	low
		• encourage the person to lean on one arm/hand while reaching with the other	✓		low	low	low
16. Lifting forces	• Lifting full pans to/from the oven and lifting ingredients from shelves	4. Change a lifting/carrying task into a rolling or pushing task					
		• provide adjustable height cards which adjust to bench, shelf and oven heights to minimize lifting		✓	med	med	med
		13. Encourage ergonomic work techniques					
		• encourage person to keep load as close to body as possible	✓		low	med	med
	• Handling oil	151. Reduce the weight of the load placed on the cart					
		• talk with vendor regarding smaller or lighter containers	✓		low	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	Level of Changes: ✓ Major Change	Cost	Impact On: Quality	Impact On: Productivity
17. Pushing or pulling	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition					
		• remove or replace broken or missing wheels	✓		low	med	med
		• remove debris between caster and coupling	✓		low	med	med
		• check bearings and tread composition to ensure ability to meet loading and movement requirements	✓		low	low	low
		119. Provide wheels		✓	med	low	low
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	med	med
		• repair cracks or gaps in floor	✓		high	med	med
		• provide ramps to compensate for minor differences in floor height		✓	med	med	med
	• Heavy/difficult to open door	11. Eliminate unnecessary tasks					
		• replace freezer door with an air curtain	✓		high	low	med
		• repair freezer doors		✓	low	med	med
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Prolonged work in a standing position	12. Incorporate rest pauses	✓		low	low	low
		25. Increase task variety	✓		low	low	low
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Standing on a hard surface 	96. Provide appropriate shoe inserts	✓		low	low	low
		86. Provide an appropriate anti-fatigue mat • provide matting designed for a food service environment and for ease of cleaning; matting should cover the entire floor surface between the grill and the food preparation surfaces		✓	med	med	low
		143. Wear appropriate shoes	✓		low	low	low
21. Awkward leg postures	• Rarely occurs	N/A					
22. Awkward foot postures	• Rarely occurs	N/A					

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	18. Improve visual access to work • Light level should be 75fc to 100fc for work		✓	low to med	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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CASE STUDY - Dishwashing	
TASK TITLE: Dishwashing	
Task Description:	The Dishwashing task involves cleaning pots, pans, plates, silverware and/or trays. The task can involve a combination of scrubbing by hand and stacking items in wash rack trays. Typical environments in which the Dishwashing task occurs can include (but are not necessarily limited to): • Cafeterias and mess halls • Restaurants • Clubs
Job Performance Measures Most Often Impacted by Dishwashing:	Measures of work performance can include (but are not necessarily limited to): • Hours daily to complete washing • Cleanliness of plates These are not formal measures currently in use.
Typical Employee Comments about Dishwashing:	Employees typically experience discomfort in the lower back and shoulders. They generally attribute this discomfort to lifting and handling items. The back/torso is the body area that most commonly receives a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	Dynamic Task Analysis, Biomechanical Lifting Analysis, Push/Pull Force Analysis

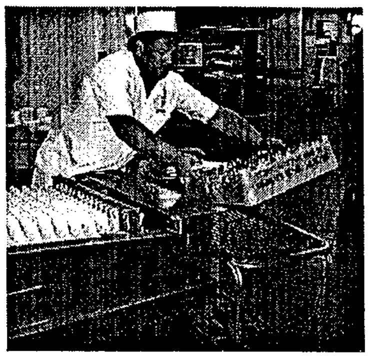
Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Reach distance for pulling tray from conveyor	38. Move closer to the work location • relocate the worker to the end of the conveyor to avoid reaching across intervening surface	✓		low	med	med
		41. Move work piece closer to body • reduce the width of the sort area		✓	med to high	med	med
		• design conveyor to flow directly to personnel with little or no intervening counter		✓	med to high	high	med
		149. Provide appropriate tools • provide a "rake" type tool to pull dishes		✓	low to med	low	low
	• Reach when flipping and aligning trays	11. Eliminate unnecessary tasks • use consistent, standard size trays		✓	low to high	high	med
	• Height of dishwasher door when opening and closing	11. Eliminate unnecessary tasks • install an auto open and close door sequencer		✓	med to high	low	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Height of dishwasher door when opening and closing (continued)	32. Lower the work piece/work surface • provide a rope extension to minimize vertical reaching	✓		low to med	low	med
	• Throwing trash in garbage can	38. Move closer to the work location • relocate trash cans • provide trash cans with wheels	✓	✓	low med	med med	med med
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Carrying stacks of plates and pans	48. Provide a cart • use existing carts • use carts with spring loaded bottoms to accommodate greater loads	✓	✓	low med to high	low low	med med
		4. Change a lifting/carrying task into a rolling or sliding task • change the work process to keep wash areas closer together in order to minimize carrying objects		✓	low to high	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Lifting full dish trays from washer to cart 	4. Change a lifting/carrying task into a rolling or sliding task					
		• reduce the height of the wash basins to allow the dish trays to slide onto carts -a sloping surface could limit water spilling on the floor while allowing easy lift over		✓	med	med	med
	• Pulling dish trays along washer	35. Maintain tracks, rollers, and movement mechanisms					
		• keep the bottom edges of the trays smooth		✓	low to med	low	med
		• install Teflon feet on the bottoms of the trays to ease movement		✓	low to med	low	med
	• Opening and closing washer door	35. Maintain tracks, rollers, and movement mechanisms					
		• perform routine lubrication and maintenance on the sliding door to limit force requirements	✓		low to med	low	med
		11. Eliminate unnecessary tasks					
		• install an auto open and close door sequencer		✓	med to high	low	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition • repair wheels on carts or equipment		✓	med	med	med
		119. Provide wheels		✓	med	med	med
	• Cart or piece of equipment is too heavy to be pushed manually	151. Reduce weight of the load placed on the cart • reduce number of items or weight of items on cart	✓		low	low	low
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	med	med
		• repair cracks or gaps in floor	✓		high	med	med
		• provide ramps to compensate for minor differences in floor height		✓	med	med	med
	• Scrubbing and scraping pots	128. Reduce force required to install or remove component					
		• soak pots repeatedly in warm, soapy water. Wipe the pots every few minutes to loosen residues	✓		low	med	high
		• provide high friction surface to stabilize pots while scrubbing		✓	low to med	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes ✓ Minor Modification	✓ Major Change	Cost	Impact On: Quality	Productivity
3. High speed, sudden shoulder movements	• Opening and closing washer door	35. Maintain tracks, rollers, and movement mechanisms					
		• perform routine lubrication and maintenance on the sliding door to limit force requirements	✓		low to med	low	high
	• Scrubbing and scraping pots	128. Reduce force required to install or remove component					
		• soak pots repeatedly in warm, soapy water. Wipe the pots every few minutes to loosen residues	✓		low	med	high
		• provide high friction surface to stabilize pots while scrubbing		✓	low to med	med	med
	• Throwing trash in garbage can	38. Move closer to the work location					
		• relocate trash cans	✓		low	med	med
		• provide trash cans with wheels		✓	med	med	med
4. Head/neck bent or twisted	• Location of work too low for good visual access, yet desirable height for arm forces applied.	12. Incorporate rest pauses	✓		low	med	med
		83. Provide an adjustable height lift table					
		• provide a riser to raise the level of the work	✓		low to med	med	med
		• provide adjustable height work surfaces		✓	med to high	med	med

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Repeated movements from scrubbing and scraping pots • Repeated movements sorting silverware and plates into bins 	128. Reduce force required to install or remove component • soak pots repeatedly in warm, soapy water. Wipe the pots every few minutes to loosen residues		✓	low to high	med	high
		• provide high friction surface to stabilize pots while scrubbing	✓		low	med	high
		11. Eliminate unnecessary tasks • institute a customer sort procedure to reduce sorting in the dish room		✓	low to med	med	med
		13. Encourage ergonomic work techniques • encourage personnel to maintain a neutral wrist position	✓		low	low	low
6. Repeated manipulations with fingers	• Repeated movements sorting silverware and plates into bins	11. Eliminate unnecessary tasks • institute a customer sort procedure to reduce sorting in the dish room		✓	low to high	med	high

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
7. Hyper-extension of finger/thumb or repeated single finger activation	• Handling multiple plates in one hand	13. Encourage ergonomic work techniques					
		• use a two-handed transfer	✓		low	med	med
		• remove one plate at a time and stack beside tray, transfer stack to the cart	✓		low	med	med
		• avoid handling large stacks of dishes all at once	✓		low	med	med
		142. Use two or more persons to perform the transfer	✓		low	med	med
		• have two people share the task					
8. Hand/grip forces	• Scrubbing and scraping pots	128. Reduce force required to install or remove component					
		• soak pots repeatedly in warm, soapy water. Wipe the pots every few minutes to loosen residues	✓		low	med	high
		• provide high friction surface to stabilize pots while scrubbing		✓	low to med	med	med
	• Forces from handling multiple plates in one hand	13. Encourage ergonomic work techniques					
		• use a two-handed transfer	✓		low	med	med
		• remove one at a time and stack beside tray, transfer stack to the cart	✓		low	med	med
		• avoid handling large stacks of dishes all at once	✓		low	med	med
		142. Use two or more persons to perform the transfer	✓		low	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Fingertip forces from prying apart pans that are stuck together	149. Provide appropriate tools • use a small wedge to separate pans • use a spoon or small pry bar to perform the prying task	✓ ✓		low low	low low	low low
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Opening and closing washer door	35. Maintain tracks, rollers, and movement mechanisms • perform routine lubrication and maintenance on the sliding door to limit force requirements	✓		low to med	low	high
	• Scrubbing and scraping pots	128. Reduce force required to install or remove component • soak pots repeatedly in warm, soapy water. Wipe the pots every few minutes to loosen residues • provide high friction surface to stabilize pots while scrubbing	✓	 ✓	low low to med	med med	high med
10. Exposure to hard edges	• Hard edges from handing trays, pans and utensils	93. Provide appropriate gloves	✓		low	low	low
11. Hands/fingers exposed to cold temperatures	• Rarely occurs	N/A					

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Reach distance for pulling tray from conveyor	38. Move closer to the work location • relocate the worker to the end of the conveyor to avoid reaching across intervening surface	✓		low	med	med
		41. Move work piece closer to body • reduce the width of the sort area • design conveyor to flow directly to personnel with little or no intervening counter	✓	✓	high high	med med	med med
		11. Eliminate unnecessary tasks • institute a customer sort procedure to reduce sorting in the dish room		✓	low to high	med	high
		149. Provide appropriate tools • provide a rake type tool to pull dishes		✓	low to med	low	low
	• Reaching under sink to retrieve dish trays	37. Modify facilities to decrease handling • Install shelves that roll out for easy access		✓	low to med	low	med
		147. Provide an alternate container • use a cart with a spring loaded base for storing dish trays		✓	med	low	med

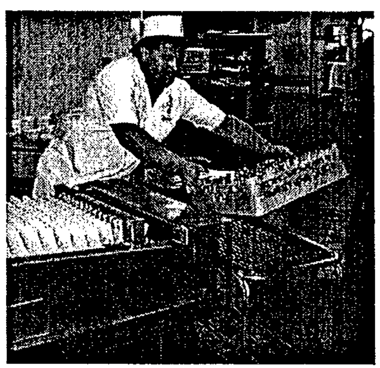
Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Stacking items on low cart causes awkward bending	147. Provide an alternate container					
		• use a cart with a spring loaded base		✓	med	low	med
	• Person tends to use the back to lift instead of using the legs to assist in the lift (check for contributing factor in the workplace)	13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	med	low
		• encourage person to use leg muscles to lift	✓		low	med	low
	• Sink too low	124. Raise the work piece/work surface					
		• provide a false bottom insert into sink to raise the work	✓		low to med	low	low
		• raise the sink		✓	med to high	high	high

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
13. Twisting of the lower back	• Work area layout	130. Reduce the angle a person has to turn to transfer an item					
		• if the transfer involves a 180 degree twist, move the source or destination to reduce the twist to 90 degrees or less	✓		low to med	low	med
		• increase space slightly between starting and ending points to encourage use of legs to turn	✓		low to med	low	med
	• Person tends to twist with the back instead of using the legs and feet to pivot	12. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	med	low
		• encourage person to use legs to pivot when handling a load	✓		low	med	low
14. High speed, sudden movements or Lifting awkward, uneven, shifting or bulky items.	• Person tends to lift with a jerky motion instead of a smooth motion	4. Change a lifting/carrying task into a rolling or sliding task					
		• use a cart to minimize carrying wet items across floor	✓		low	med	low
		13. Encourage ergonomic work techniques					
		• encourage person to use smooth fluid movements while handling items	✓		low	med	med
	• Slippery floors	17. Improve floor condition					
		• provide a non-slip walking surface that drains effectively and is easy to clean		✓	med to high	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
15. Static, awkward back postures	• Bending into sink to reach/scrub pans 	79. Provide a work surface which is adjustable in height • provide a false bottom insert into sink to raise the work • raise the sink	✓	✓	low to med med to high	low high	low high
16. Lifting forces	• Lifting full dish trays from washer to cart 	4. Change a lifting/carrying task into a rolling or sliding task • reduce the lift over height on the edge of the wash basins to allow the dish trays to slide onto carts - a sloping surface could limit water spilling on the floor while allowing easy lift over		✓	med	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	• Rolling/sliding resistance of cart or piece of equipment causes high forces	119. Provide wheels • provide wheels with appropriate bearings and tread composition		✓	med	med	med
		19. Improve wheel condition • repair wheels on carts or equipment	✓		med	med	med
	• Cart or piece of equipment is too heavy to be pushed manually	151. Reduce the weight of the load placed on the cart • reduce number of items or weight of items on cart	✓		low	med	low
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition • improve housekeeping • repair cracks or gaps in floor • provide ramps to compensate for minor differences in floor height	✓ ✓	 ✓	low med high	med med med	high high high
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Prolonged standing	20. Incorporate rest pauses	✓		low	med	med
		25. Increase task variety	✓		low	med	med
		52. Provide a footrail or footrest		✓	low to med	low	med
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Standing on a hard surface	96. Provide appropriate shoe inserts	✓		low to med	low	med
		86. Provide an appropriate anti-fatigue mat • matting should drain well and be easy to clean		✓	med to high	med	med
		143. Wear appropriate shoes	✓		low	low	low
21. Awkward leg postures	• Lack of legroom	132. Remove obstructions	✓		low	med	med
22. Awkward foot postures	• Lack of foot room	132. Remove obstructions	✓		low	med	med

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	18. Improve visual access to work • Light levels should be 50 fc – 100 fc for work		✓	low to med	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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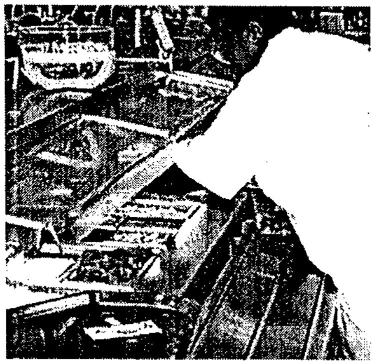
CASE STUDY – Food Serving	
TASK TITLE: Food Serving	
Task Description:	The Food Serving task occurs in a cafeteria-style environment. In this work situation, the employee typically stands behind a long service counter, which contains large heated stainless steel containers of food. Customers may request any combination of menu items from these containers. The employee serves the food onto a plate or "carry out" container using a combination of ladles, serving forks, scoops, tongs, or spatulas, and hands the plate to the customer. The customer then either places the plate on a cafeteria tray or carries the plate to the next station or check out. In this work situation, the food server's task does not include preparation of grilled items but may include replacing large containers of food into the heated service counter and replacing food items on a salad bar. Refer to Case Study 5 - Cooking (Short Order Grill). Typical jobs in which the Food Serving task occurs can include (but are not necessarily limited to): • Cafeteria • Dining Hall
Job Performance Measures Most Often Impacted by Food Serving:	Measure of work performance can include (but are not necessarily limited to): • Speed of service/waiting time (in queue) • Quality of Food Serving/presentation
Typical Employee Comments about Food Serving:	Employees typically experience discomfort in the shoulders, wrists and back. The shoulders/neck and hand/ wrists/arms are the body areas that most commonly receive a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	Elemental Task Analysis, Dynamic Task Analysis, Biomechanical Lifting Analysis.

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Food is too far away/food containers are too long 	94. Provide appropriate handles • provide serving tools with longer handles; server should be able to scoop food from the far end of the container with a relaxed reach	✓		low	low	low
		41. Move work piece closer to body • eliminate placement of self-service items in a center row; keep self-service items (which must be restocked) around the perimeter	✓		low	med	med
		• place high demand food items closest to server's primary work position	✓		low	low	low
	• Ladles are too long. This causes reaching with the hand holding the bowl	149. Provide appropriate tools • provide shorter ladles for serving soup	✓		low to med	med	med
	• Counter is too high	123. Raise the person • provide a stable platform to raise the person/make the platform as wide as the expected side to side movement of the server	✓		low	med	med
		• provide a temporary step for placing or replacing items into the serving counter or salad bar	✓		low	med	med

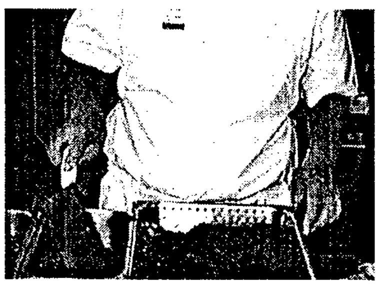
Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes ✓ Minor Modification	✓ Major Change	Cost	Impact On: Quality	Productivity
	• Glass barrier/upper counter is too high to reach over for transferring plate to customer	82. Provide adequate work space • provide a "pass through" in the glass barrier – eliminate the need to reach over the top		✓	med	low	low
	• Supplies are stored too high	32. Lower the work piece/work surface • bring materials down to a lower level		✓	low	low	med
		• store smaller quantities of supplies in the work station	✓		low	low	med
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Prolonged holding of plate while serving	11. Eliminate unnecessary tasks • do not hold plate; place plate on service counter while dispensing food items	✓		low	low	low
	• Prolonged holding/carrying of full/replacement hot food containers	48. Provide a cart • transport large food containers on carts; lift the full container only after the empty container has been removed from the service counter		✓	med	low	low
3. High speed, sudden shoulder movements	• Rarely occurs	N/A					

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
4. Head/neck bent or twisted	• Inadequate head room/access to salad bar causes awkward postures while replacing food items	82. Provide adequate work space • place popular items nearest the outside edge of the salad bar • modify glass shields such that they may be removed or pivoted out of the way during food replacement	✓	 ✓	low med to high	med med	med med

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Repeated or excessive use of ladles for serving soup or dispensing gravy	11. Eliminate unnecessary tasks • transfer soup pots to self service area		✓	high	low	high
		25. Increase task variety • avoid prolonged use of ladle by alternative work/serving positions with another employee.	✓		low	low	low
	• Inappropriate tongs design can create awkward wrist postures 	77. Provide a tool with an appropriate handle angle • purchase a variety of tongs (e.g., straight handle-to-prongs design, 90 degree handle-to-prongs design, etc.)	✓		low to med	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Lack of handles on food containers requires bent wrist grip	147. Provide an appropriate container					
		• add handles to current food containers		✓	med	low	low
		• purchase food containers with appropriate (and insulated) handles		✓	med to high	low	low
		13. Encourage ergonomic work techniques	✓		low	low	low
6. Repeated manipulations with fingers	• Making sandwiches	11. Eliminate unnecessary tasks					
		• create a self-serve sandwich bar		✓	med to high	med	med
		25. Increase task variety	✓		low	low	med
7. Hyper-extension of finger/thumb or repeated single finger activation	• Excessive use of "ice cream" type scoop for dispensing food (e.g., mashed potatoes) involves a thumb operated trigger	149. Provide appropriate tools					
		• use deep spoon to replace trigger-assisted "ice cream" type scoop	✓		low	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Excessive use of "ice cream" type scoop for dispensing food (e.g., mashed potatoes) involves a thumb operated trigger (continued)	13. Encourage ergonomic work techniques • use spatula, water or other device (as appropriate) to remove food items that stick	✓		low	low	low
8. Hand/grip forces	• Food containers are heavy and/or are difficult to grasp	131. Reduce weight of work piece • approach vendor regarding lighter weight containers		✓	high	low	low
	• Serving tools require pinch grips	94. Provide appropriate handles • add handles to current food containers		✓	med	low	low
		• purchase food containers with appropriate (and insulated) handles		✓	med to high	low	low
		88. Provide an appropriate handle diameter • provide serving tools with larger grips; grips should be insulated or sized to compensate for the use of gloves		✓	low to med	low	low
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Server technique/banging serving tool to remove food (e.g., removing grounds from espresso steamer, removing mashed potatoes from spoon)	149. Provide appropriate tools • provide serving tools with non-stick surfaces		✓	med	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
10. Exposure to hard edges	• Hard edge of handles	149. Provide appropriate tools • provide serving tools with rounded surfaces	✓		low to high	low	low
		94. Provide appropriate handles • add handles to current food containers		✓	med	low	low
		• purchase food containers with appropriate (and insulated) handles		✓	med to high	low	low
		88. Provide an appropriate handle diameter • provide serving tools with larger grips; grips should be insulated or sized to compensate for the use of gloves		✓	low to med	low	low
11. Hand and fingers exposed to cold temperatures	• Metal handles on tools • Serving and stocking cold bar	149. Provide appropriate tools • provide tools with insulated handles	✓		low to med	low	low
		25. Increase task variety	✓		low	low	low
		11. Eliminate unnecessary tasks	✓		low	low	low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Food containers on carts are too low	83. Provide an adjustable height lift table • eliminate placement of food containers (e.g., salad bar containers) on lower level of carts; use only the top level	✓		low	low	low
	• Food items are too far away 	94. Provide appropriate handles • provide serving tools with longer handles; server should be able to scoop food from the far end of the container with a relaxed reach	✓		low	low	low
		41. Move work piece closer to body • place high demand food items closest to server's primary work position	✓		low	low	med
		• eliminate placement of self-service items in a center row; keep self-service items (which must be restocked) around the perimeter	✓		low	low	med
		147. Provide an appropriate container • replace rectangular food containers with square ones		✓	med	low	low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	•Person tends to use the back to lift instead of using the legs to assist in the lift (check to make sure that there is no contributing factor in the work place)	13. Encourage ergonomics work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use leg muscles to lift	✓		low	low	low
		48. Provide a cart					
		• provide a cart with a spring loaded bottom		✓	med	low	low
13. Twisting of the lower back	• Person tends to twist with the back instead of moving the entire body	13. Encourage ergonomics work techniques					
		• provide training on ergonomics principles and proper body mechanics	✓		low	low	low
		• encourage person to move the entire body instead of reaching/twisting for items that are not directly in front	✓		low	low	low
		48. Provide a cart					
		• provide a cart with a spring loaded bottom		✓	med	low	low
		150. Re-design work space					
		• re-design work space so that adjacent work surfaces are placed at 90 degrees to one another		✓	med	low	med

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
14. High speed sudden movements or lifting awkward, uneven, shifting or bulky items.	• Person tends to lift with a jerky motion instead of a smooth motion while replacing food containers	13. Encourage ergonomic work techniques • encourage person to use smooth controlled motions while handling items	✓		low	low	low
		131. Reduce weight of work piece • approach vendor regarding lighter weight containers		✓	high	low	low
15. Static awkward back postures	• Prolonged leaning over the food service or salad bar while doing food replacement or interim cleaning	82. Provide adequate work space • provide access to all sides of the salad bar; avoid placement of bar against the wall		✓	low	med	med
		• purchase salad bar with a "U-shaped" design; interior access can be used for re-stocking		✓	high	high	high
		13. Encourage ergonomic work techniques • encourage the person to stand up straight periodically during the job	✓		low	low	low
		• encourage the person to lean on one arm/hand while reaching with the other	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
16. Lifting forces	• Item is too heavy	147. Provide an alternate container • provide smaller food containers		✓	high	low	low
		94. Provide appropriate handles • add handles to current food containers		✓	med	low	low
		• purchase food containers with appropriate (and insulated) handles		✓	high	low	low
		48. Provide a cart • provide an adjustable height cart for transporting replacement food containers; adjust cart height so that container may be slid off and into position (instead of being lifted)		✓	high	med	med
17. Pushing or pulling	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition • repair wheels on carts or equipment	✓		med	med	med
		119. Provide wheels • provide wheels with appropriate bearings and tread composition		✓	med	med	med

Back/Torso (cont.)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
		151. Reduce weight of the load placed on the cart • reduce number of items or weight of items on cart	✓		low	med	low
		17. Improve floor condition • improve housekeeping • repair cracks or gaps in floor • provide ramps to compensate for minor differences in floor height	 ✓ ✓ 	 ✓	 low high med	 med med med	 med high high
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Prolonged standing position	20. Incorporate rest pauses	✓		low	low	low
		52. Provide a footrail or foot rest		✓	med	low	low
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Standing on a hard surface 	86. Provide appropriate anti-fatigue matting		✓	med	low	low
		96. Provide appropriate shoe inserts	✓		low	low	low
		143. Wear appropriate shoes	✓		low	low	low

Legs/Feet (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
21. Awkward leg postures	• Lack of leg room 	80. Provide adequate leg clearance		✓	med to high	med	med
		132. Remove obstructions	✓		low	med	med
22. Awkward foot postures	• Lack of foot room	81. Provide appropriate toe clearance		✓	med to high	med	med
		132. Remove obstructions	✓		low	med	med

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	18. Improve visual access to work increase light levels 50fc-100fc for work		✓	low to high	med	med
24. Intensive visual tasks, staring at work object for long periods	• Rarely occurs	N/A					

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CASE STUDY - Fork Truck Operation (sitting)	
TASK TITLE: Fork Truck Operation (sitting)	
Task Description:	The Fork Truck Operation (sitting) task primarily involves driving in a sitting position. This type of truck is most commonly associated with transferring pallets of stock from one location to another, or with loading and unloading trailers. The driver must often drive backwards and twist and look over the rear of the truck to see. Loading/Unloading and Picking/Stocking are addressed in the Loading/Unloading and Picking/Stocking case studies, respectively. Typical environments in which the Fork Truck Operation (sitting) task occurs can include (but are not necessarily limited to): • Pallet transport/transfer • Loading/unloading trailers • General warehouse material handler.
Job Performance Measures Most Often Impacted by Fork Truck Operation (sitting):	While no formal process has been established to measure quality driving performance, productivity measures may sometimes include: • Number of loads or trailers per day.
Typical Employee Comments about Fork Truck Operation (sitting):	Employees typically experience discomfort and/or stiffness in the low back, shoulders/neck, and legs/feet. The back/torso is the body area that most commonly receives a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	Postural Analysis, Vibration Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Control levers/steering wheel too far away	38. Move closer to the work location • move seat forward • add backrest pad if seat cannot be moved forward	 ✓ ✓		 low low	 low low	 low low
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Pulling control levers is difficult due to poor lever maintenance or poor lever design	101. Provide appropriate controls which do not require excessive force • contact supplier to investigate adjustable and/or smoother traveling levers		✓	high	low	med
	• Turning steering wheel is difficult due to poor maintenance or poor design (e.g., non-powered)	67. Provide a powered cart • contact supplier to investigate power steering		✓	high	low	med
		35. Maintain tracks, rollers, and movement mechanisms • maintain equipment to reduce forces associated with lever action and steering	✓		low to med	low	low

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements	• Rarely occurs	N/A					
4. Head/neck bent or twisted	• Work location/path of travel located behind operator	147. Provide an alternate container • reduce the height of pallet loads when practical	✓		low	med	med
	• Fixed position of the seat requires extreme twist	13. Encourage ergonomic work techniques • encourage the operator to shift his/her whole body rather than just the head/neck	✓		low	low	low
		87. Provide an appropriate chair/stool • contact supplier to investigate acquiring the option of swivel (rotate to between 45 and 90 degrees of a fixed position) seat for use when driving backwards (Note: steering contents will stay fixed but swiveling seat allows for a more "neutral" neck position)		✓	med	low	med
		20. Incorporate rest pauses	✓		low	low	low
		25. Increase task variety	✓		low	low	low

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Fork truck control lever location too high or is at an inappropriate angle	123. Raise the person • adjust the chair height • add a cushion to the seat 101. Provide appropriate controls which do not require excessive force • contact supplier to investigate adjustable levers or speed knob option to improve wrist posture	 ✓ ✓	 ✓	 low low low to med	 low low low	 low low med
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Rarely occurs	N/A					

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
8. Hand/grip forces	• Pulling control levers is difficult due to poor lever maintenance or poor lever design	101. Provide appropriate controls which do not require excessive force • contact supplier to investigate adjustable and/or smoother traveling levers		✓	high	low	med
	• Turning steering wheel is difficult due to poor maintenance or poor design (e.g., non-powered)	67. Provide a powered cart • contact supplier to investigate power steering		✓	high	low	med
		35. Maintain tracks, rollers, and movement equipment • maintain equipment to reduce forces associated with lever action and steering	✓		low to med	low	low
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Control levers or steering wheel transfers excessive vibration	101. Provide appropriate controls which do not require excessive force • provide levers and steering wheels that include vibration dampening materials		✓	high	low	low
		35. Maintain tracks, rollers, and movement equipment • keep fork trucks in top condition and conduct vibration measurement when appropriate	✓		low	low	low

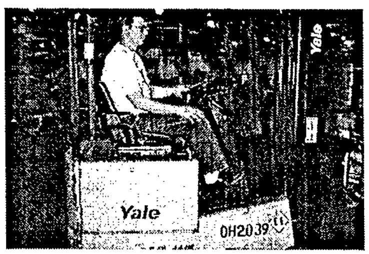
Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
10. Exposure to hard edges	• Hard edges on steering wheel	54. Provide a high friction gripping surface					
		• provide a compressible wrap for the steering wheel	✓		low to med	low	low
11. Hands and fingers exposed to cold temperatures	• Work area is too cold	23. Increase room temperature					
		• encourage employees to keep doors shut	✓		low	low	low
		• provide portable heaters near trailers		✓	med	low	low
		• provide and use adjustable seals around individual trailer bays		✓	high	low	low
		93. Provide appropriate gloves	✓		low	low	low
		12. Encourage appropriate seasonal clothing	✓		low	low	low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Control levers positioned too far away	38. Move closer to the work location					
		• move seat forward	✓		low	low	low
		• add backrest pad if seat cannot be moved forward	✓		low	low	low
	• Driver cannot reach foot pedals without sitting on the forward edge of the seat and leaning forward	101. Provide alternative controls which do not require excessive force		✓	med	low	med
		• contact supplier to investigate adjustable foot pedals or foot pedal extensions	✓		low	low	med
		• add blocks or extensions to current footpedals					
13. Twisting of the lower back	• Work location/path of travel located behind operator • Fixed position of the seat requires extreme twist	87. Provide an appropriate chair/stool		✓	med	low	med
		• contact supplier to investigate acquiring the optional swivel (rotate to between 45 and 90 degrees to a fixed position) seat for use when driving backwards					
		20. Incorporate rest pauses	✓		low	low	low
		25. Increase task variety	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
14. High speed, sudden movements **or** Lifting awkward, uneven, shifting or bulky items.	• Rarely occurs	N/A					
15. Static, awkward back postures	• Inadequate chair/seat design and/or adjustment 	87. Provide an appropriate chair/stool		✓	med	low	med
		115. Provide support for the lower back					
		• adjust back support forward	✓		low	low	low
		• encourage person to sit upright and let the backrest support the body	✓		low	low	low
		• add a backrest cushion	✓		low	low	low
	• Prolonged driving	20. Incorporate rest pauses	✓		low	low	low
		25. Increase task variety	✓		low	low	low
	• Control levers positioned too far away	38. Move closer to the work location					
		• move seat forward	✓		low	low	low
		• add backrest pad if seat cannot be moved forward	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
15. Static, awkward back postures	• Control levers positioned too far away (continued)	101. Provide appropriate controls which to not require excessive force					
		• contact supplier to investigate adjustable foot pedals or foot pedal extensions		✓	med	low	med
		• add blocks or extensions to current foot pedals	✓		low	low	med
15. Lifting forces	• Rarely occurs	N/A					
16. Pushing or pulling	• Rarely occurs	N/A					
18. Whole body vibration	• Poor design and/or maintenance of seat and mounting may increase vibration transmission between the truck and the driver	87. Provide an appropriate chair/stool					
		• seat/mounting should incorporate the use of shock and vibration absorbing devices		✓	med	low	med
		35. Maintain tracks, rollers, and movement mechanisms					
		• keep fork trucks in top condition and conduct vibration measurement when appropriate	✓		low	low	low
	• Floor/surface condition causes shock or high forces during transport	17. Improve floor condition					
		• improve housekeeping	✓		low	low	low
		• repair cracks or gaps in floor	✓		high	low	med

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Rarely occurs	N/A					
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Hard edge or seat may create pressure point on underside of thighs	9. Eliminate exposure to hard edges • use an additional seat cushion; cut padding and recover the seat pan to create a waterfall or downward curve to the front edge of the seat	✓		low	low	low
		87. Provide an appropriate chair/stool • investigate replacing/improving vehicle seats		✓	high	low	high
21. Awkward leg postures	• Rarely occurs	N/A					
22. Awkward foot postures	• Foot pedals are too far away or are at an inappropriate angle for the driver	101. Provide appropriate controls which do not require excessive force • contact supplier to investigate adjustable foot pedals or foot pedal extensions		✓	med	low	med
		• attach blocks or extensions to current foot pedals in order to change the pedal height and angle	✓		low	low	med
		38. Move closer to the work location • move seat forward	✓		low	low	low
		• add backrest pad if seat cannot be moved forward	✓		low	low	low

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Dimly lit trailers increase potential for accidents	18. Improve visual access to work • Light levels should be 50fc to 75fc for work • provide spot light to illuminate trailer contents		 ✓ ✓	low to med med	med med	med med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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CASE STUDY - Fork Truck Operation (standing)	
TASK TITLE: Fork Truck Operation (standing)	
Task Description:	The Fork Truck Operation (standing) task primarily requires the driver to stand while operating the lift truck. This type of truck is most commonly associated with obtaining stock from pick tunnels in a warehouse setting. This driving task may also include the use of standing trucks known as "mules" which may be used to push or pull carts and/or transport palletized loads. This case study does not include lifting tasks associated with obtaining stock from pick tunnels. For lifting tasks associated with picking stock from pick tunnels, please see Case Study 17 – Picking/Stocking. Also refer to Case Study 11 – Loading and Unloading, or Case Study 22 – Lifting. Typical environments in which the standing driving task occurs include (not necessarily limited to): • Stock picker/pick tunnel • General warehouse material handler.
Job Performance Measures Most Often Impacted by Fork Truck Operation (standing):	Measure of work performance can include (but are not necessarily limited to): • Pick rate • Number of loads per day.
Typical Employee Comments about Fork Truck Operation (standing):	Employees typically experience discomfort in the low back, and shoulders. The back/torso and legs/knees/feet are the body areas that most commonly receive a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	Postural Analysis, Vibration Analysis, Biomechanical Lifting Analysis, NIOSH Lifting Equation

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Controls levers are too high or too far away	41. Move work piece closer to body • relocate or lower keypads or other stock tracking equipment	✓		low	low	med
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Pulling control levers is difficult due to poor lever maintenance or poor lever design	101. Provide appropriate controls which do not require excessive force • contact supplier to investigate adjustable and/or smoother traveling levers		✓	high	low	med
	• Turning steering wheel is difficult due to poor maintenance or poor design (e.g., non-powered)	148. Provide appropriate equipment • contact supplier to investigate power steering		✓	high	low	med
		35. Maintain tracks, rollers, and movement mechanisms • maintain equipment to reduce forces associated with lever action and steering	✓		low to med	low	low
3. High speed, sudden shoulder movements	• Rarely occurs	N/A					

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
4. Head/neck bent or twisted	• Work location/path of travel located behind operator	147. Provide an alternate container • reduce the height of pallet loads when practical	✓		low	med	med
		13. Encourage ergonomic work techniques • encourage the operator to shift his/her whole body rather than just the head/neck	✓		low	low	low
		20. Incorporate rest pauses	✓		low	low	low
		25. Increase task variety	✓		low	low	low
	• Looking up at stacks for prolonged periods	84. Provide an adjustable mirror • provide mirrors for seeing high up		✓	med	low	low
	• Difficult to see around overhead guarding	148. Provide appropriate equipment • select models with improved cage visibility		✓	high	med	med
		• replace cage with reinforced clear plastic sheet		✓	med	med	med
	• Controls are too high or too far away	41. Move work piece closer to body • relocate or lower keypads or other stock tracking equipment	✓		low	low	med

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Fork truck control design requires operator to repeatedly bend the wrist back and forth.	35. Maintain tracks, rollers, and movement mechanisms • maintain fork truck controls to require a minimum of wrist movement	✓		low	low	med
		101. Provide appropriate controls which do not require excessive force • contact supplier to investigate adjustable levers or speed knob option to improve wrist posture		✓	low to med	low	low
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Wide handle span or single finger activation on fork truck controls	101. Provide appropriate controls which do not require excessive force • provide controls with multi-finger triggers and which allows the thumb and finger to be together		✓	high	low	low
8. Hand/grip forces	• Pulling control levers is difficult due to poor lever maintenance or poor lever design	101. Provide appropriate controls which do not require excessive force • contact supplier to investigate adjustable and/or smoother traveling levers		✓	high	low	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Turning steering wheel is difficult due to poor maintenance or poor design (e.g., non-powered)	148. Provide appropriate equipement • contact vendor to investigate purchase of powered steering option		✓	high	low	med
		35. Maintain tracks, rollers, and movement mechanisms • maintain equipment to reduce forces associated with lever action and steering	✓		low	low	low
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Fork truck control design requires operator to repeatedly bend the wrist back and forth.	35. Maintain tracks, rollers, and movement mechanisms • maintain fork truck controls to require a minimum of wrist movement	✓		low	low	low
10. Exposure to hard edges	• Rarely occurs	N/A					
11. Hand/fingers exposed to cold temperatures	• Work area is too cold	93. Provide appropriate gloves	✓		low	low	low
		12. Encourage appropriate seasonal clothing	✓		low	low	low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Looking at stack for bar code	18. Improve visual access to work • increase size of pallet rack's bar code label		✓	low to med	med	med
13. Twisting of the lower back	• Looking at stack for bar code	18. Improve visual access to work • increase size of pallet rack's bar code label		✓	low to med	med	med
14. High speed, sudden movements or Lifting awkward, uneven, shifting or bulky items.	• Rarely occurs	N/A					
15. Static, awkward back postures	• Viewing around load	147. Provide an alternate container • reduce the height of pallet loads when practical	✓		low	med	med
		84. Provide an adjustable mirrors	✓		low	low	low
	• Looking up at stacks for prolonged periods	84. Provide adjustable mirrors • provide mirrors for seeing high up	✓		low	low	low
	• Difficult to see around overhead guarding	148. Provide appropriate equipment • select models with improved cage visibility		✓	high	med	med
		• replace cage with reinforced clear plastic sheet		✓	med	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Difficult to see around overhead guarding	11. Eliminate unnecessary tasks • move entire pallet rather than moving heavy objects off the pallet. This may require relocating the stock location	✓		low to high	low	med
16. Lifting forces	• Rarely occurs	N/A					
17. Pushing or pulling	• Rarely occurs	N/A					
18. Whole body vibration	• Truck or standing surface may increase exposure to vibration	35. Maintain tracks, rollers, and movement mechanisms • keep fork trucks in top condition and conduct vibration measurement when appropriate	✓		low	low	low
	• Floor/surface condition causes shock or high forces during transport	17. Improve floor condition • repair cracks or gaps in floor		✓	high	low	med

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Rarely occurs	N/A					
20. Exposure to hard edges on legs, knees, and feet <u>or</u> Standing on hard surfaces	• Leaning against racks or cages may expose legs to hard edges	9. Eliminate exposure to hard edges					
		• wrap hard edges of cages with padding	✓		low	low	low
		• provide knee pads when appropriate	✓		low	low	low
21. Awkward leg postures	• Operating foot pedals • Lack of foot space	101. Provide appropriate controls which do not require excessive force					
		• substitute hand controls for foot controls		✓	med to high	low	low
		50. Provide a foot pedal which requires the correct amount of force to use					
		• provide heel support for foot pedal	✓		low to med	low	low
		• provide a place to rest back while operating the pedal		✓	low to high	med	med
		80. Provide adequate leg clearance					
		• contact vendor to investigate alternative vehicles with increased leg clearances		✓	med to high	med	med

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
22. Awkward foot postures	• Operating foot pedals • Lack of foot space	134. Replace standing foot pedals with alternative controls • substitute hand controls for foot controls		✓	med to high	low	low
		145. Modify foot pedal • provide a heel support for foot pedal	✓		low to med	low	low

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Hard to read stock list	18. Improve visual access to work • provide task light inside truck to illuminate stock list		✓	low to med	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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CASE STUDY – Inspect and Repair Support Equipment	
TASK TITLE: Inspect and Repair Support Equipment	
Task Description:	The Inspect and Repair Support Equipment task can involve life jackets, rafts, parachutes and oxygen masks. The task requires the person to visually inspect the work piece, remove components, repair components if required, and reassemble the components. Repair can include sewing, bolting and screwing components, as well as cutting and cleaning. Additionally, refer to the M/I Guide for case studies on Case Study 41- Sewing; Case Study 4 - Bolting/Screwing and Case Study 33 – Packing. Typical jobs in which Inspect and Repair Support Equipment tasks occur (but are not necessarily limited to) can include: • Oxygen masks • Life Rafts • Life Jackets
Job Performance Measures Most Often Impacted by Inspect and Repair Support Equipment :	Measures of work performance can include (not necessarily limited to): • Quality of the repairs and inspections • Number of pieces completed
Typical Employee Comments about Inspect and Repair Support Equipment:	Employees typically experience discomfort in the hands/wrists/arms, shoulder/neck, and head/eyes. The hands/wrists/arms and shoulder/neck are the body areas that most commonly receive a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive "Medium" priority rating, or lower.
Suggested Level II Analysis:	Biomechanical Lifting Analysis, Push/Pull Force Analysis, Grip Force

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Object too high	120. Raise the chair • raise the chair and provide a footrest if the feet are unsupported	✓		low	low	med
		32. Lower the work piece/work surface • lower the table or object so that the individual is positioned at or just below elbow level when assembly parts or removing parts	✓		low	low	med
		123. Raise the person • provide a platform to raise the person in relation to the object	✓		low	low	med
	• Object too far away	41. Move work piece closer to body • pull the object close to the work surface edge rather than reaching across the surface	✓		low	low	low
2. Arm forces: Repeated are forces or holding/ carrying materials	• Item is too heavy	61. Provide a mechanical lift device • provide a portable engine hoist-type crane with four point attachment		✓	high	high	high
		131. Reduce weight of work piece • reduce the weight of the object (raft) by moving individual components separately	✓		low	low	low
		142. Use two or more persons to perform the transfer	✓		low	low	low

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Pulling ties on chutes	55. Provide a hook-type tool to pull items					
		• provide t-handle hook tools for pulling ties	✓		low	low	low
		• provide stable winch device to pull ties	✓		low	low	low
	• Use hand to compress item	148. Provide appropriate equipment					
		• use a heavy weight and lift device to compress materials	✓		med to high	med	med
	• High forces required to install or remove component	128. Reduce force required to install or remove the component					
		• use lubricant where feasible	✓		low	low	med
		• modify design of component or subsystem to reduce forces during installation or removal		✓	high	med	med
	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition					
		• repair wheels on carts or equipment	✓		low	low	low
		119. Provide wheels	✓		low	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Cart or piece of equipment is too heavy to be pushed manually	67. Provide a powered cart					
		• provide a powered cart to move large life rafts		✓	high	med	med
		• redesign existing life raft containers so that the containers have wheels		✓	med	med	med
		151. Reduce weight of the load placed on the cart					
		• reduce number of items or weight of items on cart	✓		low	low	low
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	med	high
		• repair cracks or gaps in floor	✓		med	med	med
		• provide ramps to compensate for minor differences in floor height		✓	high	med	med
	• Carry distance is more than three steps	126. Reduce carry distance					
		• arrange storage and work areas to reduce travel distances	✓		low	low	med
		67. Provide a powered cart		✓	high	low	med
		11. Eliminate unnecessary tasks					
		• eliminate or combine handling tasks	✓		low	med	med
		• transport items in larger quantities instead of handling them individually	✓		low	med	med

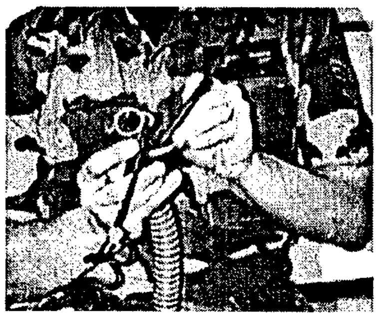
Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Carry distance is more than three steps (continued)	37. Modify facilities to decrease handling • widen doors to allow materials to be handled on carts		✓	high	med	med
3. High speed, sudden shoulder movements	• Item is difficult to move	128. Reduce force required to install or remove the component • use lubricant when possible • modify design of component or subsystem to reduce forces during installation or removal	✓	✓	low high	med med	med med
4. Head/neck bent or twisted	• Objects positioned flat on work surface or too low 	124. Raise the work piece/work surface • elevate the work piece by raising the table 146. Angle the work surface • angle the work surface forward 15 degrees or tilt the work piece by supporting it with a slanted surface	✓ ✓		med med	med med	med med

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Sewing with a needle causes awkward wrist positions	66. Provide a power tool • use a sewing machine to perform routine sewing tasks		✓	high	high	high
		20. Incorporate rest pauses	✓		low	low	low
	• Reaching for components located off to one side	41. Move work piece closer to body • place the components directly in front of the individual or next to the individual	✓		low	low	low
		149. Provide appropriate tools • use a hook type tool to pull items	✓		low	low	med
	• Cutting fabric or components	77. Provide a tool with an appropriate handle angle • provide angled scissors that bend the tool rather than the wrist	✓		low	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
6. Repeated manipulations with fingers	• Hand tying/pulling • Assemble and disassemble masks 	25. Increase task variety • alternate between different tasks (e.g. packing chutes and sewing)	✓		low	low	low
		20. Incorporate rest pauses	✓		low	low	low
7. Hyper-extension of finger/thumb or repeated single finger activation	• Cutting fabric	149. Provide appropriate tools • provide a mechanized power cutting tool	✓		med	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
8. Hand/grip forces	• Item is difficult to grasp • Item has no handles • Item is bulky • Item is slick making grasp difficult	94. Provide appropriate handles • provide or fabricate handles on the life raft	✓		low	low	low
		61. Provide a mechanical lift device		✓	high	high	med
	• Sewing with a needle	149. Provide appropriate tools • provide a small tool to help drive the sewing needle through tough material - the tool could be a solid block of wood or metal thimble that would allow the individual to use a power grip rather than a pinch grip to push the needle through the fabric.	✓		low	low	low
	• High force required to snap components into place or remove	148. Provide appropriate equipment • provide a small presses to insert/remove components		✓	med	high	low
	• Pulling ties on chutes	55. Provide a hook-type tool to pull items • provide stable winch device to pull ties	✓		low	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Pulling cord	25. Increase task variety • alternate between different tasks (e.g. packing chutes and sewing)	✓		low	low	low
		55. Provide a hook-type tool to pull items • provide stable winch device to pull ties	✓		low	low	low
	• Use hand to compress item	148. Provide appropriate equipment • use a heavy weight and a lift device to compress materials	✓		med to high	med	med
	• Hard edges on tool handles	149. Provide appropriate tools • provide tools with rounded compressible handles with no pressure points in the hand	✓		low to med	low	low
9. Exposure to hard edges	• Edge of worksurface	9. Eliminate exposure to hard edges • cover hard edges with a compressible pad	✓		low to med	low	low
		• round off hard edges	✓		low to med	low	low
11. Hands and fingers exposed to cold temperatures	• Rarely occurs	N/A					

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Object is too low • Packing chutes/rafts on floor	124. Raise the work piece/work surface					
		• place heaviest items between knuckle and shoulder height (25"-50") (64-127 cm)	✓		low	low	low
		• provide tables to pack chutes/rafts		✓	med	med	med
		• provide an adjustable table or scissor lift for work piece		✓	high	med	med
	• Object is too far away • Person tends to use the back to lift instead of using the legs to assist in the lift (Check to make sure that there is no contributing factor in the workplace)	38. Move closer to the work location					
		• remove obstructions under the surface or in front of the surface	✓		low	low	low
		41. Move work piece closer to body	✓		low	low	low
		61. Provide a mechanical lift device					
		• provide a spring-loaded table or materials handling device (e.g., vacu-hoist) to move the object		✓	high	high	high
		13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use leg muscles to lift	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
13. Twisting of the lower back	• Access is restricted to a component that needs to be removed	82. Provide adequate work space • improve access to items stored on shelves	✓		low	med	med
		61. Provide a mechanical lift device • provide mechanical assistance for handling the load		✓	high	med	med
	• Person tends to twist with the back instead of using the legs and feet to pivot	130. Reduce the angle a person has to turn to transfer an item • for example, if the transfer involves a 180 degree twist, move the source or destination to reduce the twist to 90 degrees or less	✓		low	low	low
		150. Re-design work space • re-design the work space so that adjacent work areas are at 90 degrees to one another		✓	high	high	high
		13. Encourage ergonomic work techniques • provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use legs to pivot when handling a load	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
14. High speed, sudden movements or lifting awkward, uneven, shifting or bulky items.	• Oxygen mask component stuck in location	128. Reduce force required to install or remove the component					
		• use lubricant when feasible	✓		low	med	med
		• modify design of component or subsystem to reduce forces during installation or removal		✓	high	med	med
	• High forces are required to pack item	148. Provide appropriate equipment • use a heavy weight and a lift device to compress materials		✓	med to high	med	med
	• Person tends to lift raft with a jerky motion instead of a smooth motion	61. Provide a mechanical lift device • provide a portable hoist or crane with four-point attachment to lift and move the raft		✓	high	high	high
		13. Encourage ergonomic work techniques • encourage person to use smooth controlled motions while handling items	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
15. Static, awkward back postures	• Object located too low • Packing chutes and rafts on floor	124. Raise the work piece/work surface					
		• place heaviest items between knuckle and shoulder height (25"-50") (64-127 cm)	✓		low	low	med
		• provide a table to pack chutes and rafts	✓		low	med	med
		• provide an adjustable table or scissor lift for work piece		✓	high	med	med
		38. Move closer to the work location • remove obstructions	✓		low	low	med
		41. Move work piece closer to body	✓		low	low	low
16. Lifting forces	• Item is too heavy	61. Provide a mechanical lift devuce		✓	high	med	med
		142. Use two or more persons to perform the transfer	✓		low	low	low
	• High forces are required to pack item	128. Reduce force required to install or remove the component					
		• use a mechanical device to place pressure on the life raft when packing into the container		✓	high	med	med
		• use a device to extract the remaining air in the life raft so that the raft is small and compact		✓	high	low	med
		• modify design of component or subsystem to reduce forces during installation or removal		✓	high	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition • repair wheels on carts or equipment	✓		low	low	med
		119. Provide wheels • check bearings and tread composition to ensure ability to meet loading and movement requirements	✓		low	low	med
	• Cart or piece of equipment is too heavy to be pushed manually	67. Provide a powered cart • provide motorized assistance to transport cart or piece of equipment		✓	high	med	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition • improve housekeeping • repair cracks or gaps in floor • provide ramps to compensate for minor differences in floor height	 ✓ ✓ 	 ✓	 low low high	 low low med	 med med med
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Prolonged standing	1. Alternate between sitting and standing tasks	✓		low	low	med
		52. Provide a footrest or footrail • encourage footrest use	✓		med	med	low
		86. Provide an appropriate anti-fatigue mat • provide anti-fatigue matting in front of work tables where the person must stand for extended period of time		✓	med	low	low
		• investigate the feasibility of running anti-fatigue matting the entire length of the parachute table		✓	med	low	med
		96. Provide appropriate shoe inserts	✓		low	low	med
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Lack of forward and vertical leg room when working in a seated position	150. Re-design work space • provide a work bench that accommodates both adequate vertical and horizontal leg room – the table thickness should be no greater than 1.5 inches (3.8 cm) to accommodate vertical leg room	✓		high	med	med low
		1. Alternate between siting and standing tasks	✓		low	low	med

Legs/Feet (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Legs dangle from chair • Edge of seat presses into back of legs	87. Provide an appropriate chair/stool • provide a chair with the appropriate seat pan		✓	high	med	med
	• Kneeling on a hard surface while packing life rafts	95. Provide appropriate knee protection	✓		low	med	med
21. Awkward leg postures	• Work object is too low • Packing chutes/rafts on floor	124. Raise the work piece/work surface • provide an adjustable table for work piece		✓	high	med	med
		• provide tables to pack chutes/rafts	✓		low	med	med
		20. Incorporate rest pauses	✓		low	low	low
22. Awkward foot postures	• Packing chutes/rafts on floor	124. Raise the work piece/work surface • provide an adjustable table for work piece		✓	high	med	med
		• provide tables to pack chutes/rafts		✓	low	med	med

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Low light level due to location of the component	18. Improve visual access to work • provide a portable task light that can be moved around the area or clamped onto a support work surface to improve light levels (Light level should be 150fc to 200fc for work)		✓	low to med	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Work on small components	60. Provide a magnifying glass • provide a magnifying glass that will magnify the work piece - the magnifier should be height, angle and horizontally adjustable		✓	med	med	med

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CASE STUDY – Loading and Unloading

TASK TITLE: Loading and Unloading

Task Description:	The Loading and Unloading task, which can occur in a wide variety of jobs, often occurs as part of another job. For instance, meat cutters often must load boxes of meat onto carts and unload onto the cutting area. Other case studies that may provide additional information on related tasks are as follows: In the M/I Guide: Lifting – Case Study 22; in the W/S Guide Supplement Fork Truck Operation (sitting) (Case Study #8) Fork Truck Operation (standing) (Case Study #9), Packing/Shipping (Case Study #14), Picking/Stocking (Case Study #17), and Transporting Loads on Non Powered Carts (Case Study #20). Typical environments in which the Loading and Unloading task may be found can include: • Loading docks • Storage areas • Maintenance shops • Mail rooms
Job Performance Measures Most Often Impacted by Loading and Unloading:	Measure of work performance can include (but are not necessarily limited to): • Time per box • Rate of damaged boxes In most applications, there are no formal measures.
Typical Employee Comments about Loading and Unloading:	Employees typically experience discomfort in the lower or middle back. The back/torso is the body area that most commonly receives a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	NIOSH Lifting Equation, Biomechanical Lifting Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Object is too high	32. Lower the work piece/work surface • place heaviest items below shoulder height and above knuckle height (25”-50”) (64-127cm)	✓		low	low	med
	• Object is too far away	38. Move closer to the work location • step closer to load	✓		low	low	low
		41. Move work piece closer to body • slide load to edge before lifting	✓		low	low	low
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Item is too heavy	4. Change a lifting/carrying task into a rolling or sliding task • use a lift cart to retrieve and deliver objects – the operator can slide objects rather than lift		✓	low to med	med	med
		61. Provide a mechanical lift device		✓	med	low	low
		142. Use two or more persons to perform the transfer	✓		low	low	low
		26. Increase weight of work piece • increase work piece mass to ensure handling with a lifting device		✓	low to high	low	low
		131. Reduce weight of work piece • contact vendor and inquire about receiving units in less mass		✓	med	low	low

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Item is stuck or wedged in place	132. Remove obstructions • take time to remove obstacles interfering with movement rather than trying to "force" the object free	✓		low	low	low
		149. Provide appropriate tool • provide a tool that would help dislodge the item, without using excessive force		✓	low	low	med
	• Rolling/sliding resistance of cart causes high forces • Pulling object across shelf results in high forces	19. Improve wheel condition • repair wheels on carts or equipment	✓		low	low	high
		119. Provide wheels • install appropriate wheels	✓		med	low	low
		46. Provide a ball-bearing rotation table • provide a ball-bearing rotation table to slide the object closer		✓	med to high	low	med
		151. Reduce weight of the load placed on the cart	✓		low	low	low
	• Cart or piece of equipment is too heavy to be pushed manually	67. Provide a powered cart (Note: This may require wide doors and/or ramps.)		✓	high	low	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	med	med
		• repair cracks or gaps in floor	✓		low	med	med
		• provide ramps to compensate for minor differences in floor height		✓	high	med	med
	• Carry distance is more than three steps	126. Reduce carry distance					
		• arrange storage and work areas to reduce travel distances		✓	low to high	low	high
		67. Provide a powered cart (Note: This may require wide doors and/or ramps.)		✓	high	low	med
		11. Eliminate unnecessary tasks					
		• eliminate or combine handling tasks	✓		low	low	high
		• transport items in larger quantities instead of handling them individually (Note: Exercise caution when increasing quantities in a load to avoid overloading the operator. Using powered assistance is the best strategy in this case)		✓	med to high	low	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements	• Speed of lift	13. Encourage ergonomic work techniques • encourage person to use smooth controlled motions while handling items	✓		low	low	low
		61. Provide a mechanical lift device		✓	med to high	med	high
4. Head/neck bent or twisted	• Inadequate head room causes awkward postures	82. Provide adequate workspace • store item in area where there is adequate headroom	✓		low	med	med
		• use flow-racks to cue items to the front of a storage rack		✓	high	med	high
		55. Provide a hook-type tool to pull items		✓	med	med	high

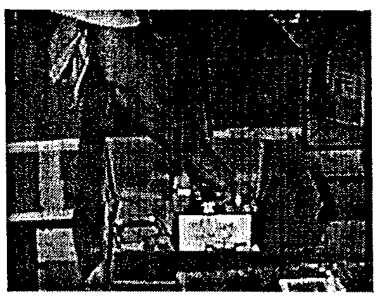
Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Shape of grasping location (handle) on work piece causes awkward wrist positions	94. Provide appropriate handles • provide handles which pivot slightly to permit a straight wrist during handling • provide cut-outs on boxes or containers		 ✓ ✓	 med med	 low med	 low med
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Handling large products	147. Provide alternate container • provide a smaller container • provide a more stable container 94. Provide appropriate handles 61. Provide a mechanical lift device		 ✓ ✓ ✓ ✓	 med med med med	 med med med med	 med med med low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
8. Hand/grip forces	• Item is difficult to grasp • Item has no handles • Item is slippery	147. Provide an alternate container					
		• provide a smaller container	✓	✓	med	med	med
		• provide a more stable container	✓	✓	med	med	med
		94. Provide appropriate handles		✓	med	med	med
		93. Provide appropriate gloves • provide gloves with a high friction surface	✓		low	low	low
	• Item is too heavy	4. Change a lifting/carrying task into a rolling or sliding task • use a portable lift cart to retrieve and deliver objects - the operator can slide objects rather than lift		✓	low to med	med	med
		61. Provide a mechanical lift device		✓	med	low	low
		142.Use two or more persons to perform the transfer	✓		low	low	low
		131.Reduce weight of work piece	✓	✓	low to high	low	low
	• Item is stuck or wedged in place	132.Remove obstructions • take time to remove obstacles interfering with movement. Avoid trying to "force" the object free	✓		low	low	high

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Item is stuck or wedged in place (continued)	149. Provide appropriate tools • provide a pry bar or wedge	✓		med	low	low
		61. Provide a mechanical lift device		✓	med to high	med	med
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Tearing open boxes	149. Provide appropriate tools					
		• use a utility knife for opening boxes	✓		low	med	med
		• if performing highly repetitive box opening, use a knife with an angled handle	✓		low	med	med
10. Exposure to hard edges	• Item has small handles	88. Provide appropriate handle diameter	✓		low to med	low	low
	• Handles have hard edges 	94. Provide appropriate handles • provide rounded slightly compressible handles		✓	low to med	low	low
		61. Provide a mechanical lift device		✓	med to high	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
11. Hands and fingers exposed to cold temperatures	• Work area is too cold	12. Encourage appropriate seasonal clothing	✓		low to med	med	med
		93. Provide appropriate gloves	✓		low to med	med	low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Object is too low 	124. Raise the work piece/work surface					
		• place heaviest items between knuckle and shoulder height and on middle shelves of storage racks	✓		low	med	med
		• provide a fixed table to support work piece		✓	med	med	med
		• provide an adjustable table		✓	med to high	med	med
	• Object is too far away 	38. Move closer to the work location					
		• step closer to load	✓		low	med	low
		41. Move work piece closer to body					
		• slide load to edge before lifting	✓		low	med	low
		46. Provide a ball-bearing rotation table					
		• provide a ball-bearing transfer table to slide the object closer		✓	med to high	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Lifting item out of a deep container causes awkward bending • Person tends to use the back to lift instead of using the legs to assist in the lift (check to make sure that there is no contributing factor in the workplace)	147. Provide alternate container					
		• use a smaller container		✓	high	med	med
		• use a container with drop down sides		✓	high	med	med
		• use a pallet instead of a bin		✓	med	med	med
		13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use leg muscles to lift	✓		low	low	low
13. Twisting of the lower back	• Work area layout	130. Reduce the angle a person has to turn to transfer the item					
		• for example, if the transfer involves a 180 degree twist, move the source or destination to reduce the twist to 90 degrees or less	✓	✓	low to high	low	med
		• reposition supplies/materials to reduce twisting	✓		low	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes ✓ Minor Modification	✓ Major Change	Cost	Impact On: Quality	Productivity
	• Person tends to twist with the back instead of using the legs and feet to pivot 	13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use legs to pivot when handling a load	✓		low	low	low
		130. Reduce the angle a person has to turn to transfer an item					
		• place adjacent pallets at 90° to one another		✓	med	low	med
14. High speed, sudden movements or Lifting awkward, uneven, shifting or bulky items.	• Item is bulky, awkward and/or shifts easily	61. Provide a mechanical lift device		✓	med to high	med	med
	• Person tends to lift with a jerky motion instead of a smooth motion	13. Encourage ergonomic work techniques					
		• encourage person to use smooth controlled movements while handling items	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes ✓ Minor Modification	✓ Major Change	Cost	Impact On Quality	Productivity
15. Static, awkward back postures	• Sorting from a low location	124. Raise the work piece/ work surface					
		• place heaviest items between knuckle and shoulder height and on middle shelves of storage racks	✓		low	med	med
		• provide a fixed table to support work piece		✓	med	med	med
		• provide an adjustable table		✓	med to high	med	med
16. Lifting forces	• Item is too heavy	61. Provide a mechanical lift device		✓	med to high	med	med
		142. Use two or more persons to perform the transfer	✓				
17. Pushing or pulling	• Rolling/sliding resistance of cart or piece of equipment causes high forces 	19. Improve wheel condition					
		• repair wheels on carts or equipment		✓	med	med	med
		119. Provide wheels					
		• provide wheels with appropriate bearings and tread composition		✓	med	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Cart or piece of equipment is too heavy to be pushed manually	151. Reduce the weight of the load placed on the cart					
		• reduce number of items or weight of items on cart	✓		low	med	low
		67. Provide a powered cart					
		• provide motorized assistance to transport cart or piece of equipment		✓	med to high	med	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	med	med
		• repair cracks or gaps in floor	✓		high	med	med
		• provide ramps to compensate for minor differences in floor height		✓	med	low	low
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Rarely occurs	N/A					
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Standing on hard surface	86. Provide an appropriate anti-fatigue mat	✓		low to med	low	med
		96. Provide appropriate shoe inserts	✓		low	low	low
	• Leaning against bin during loading	147. Provide an alternate container • use a smaller container • use a container with drop down sides		✓ ✓	med low	low low	med low
		95. Provide appropriate knee protection	✓		low	low	low
21. Awkward leg postures	• Work object is too low, causing the foot to bend at the toes for balance	124. Raise the work piece/work surface • provide support for the work piece • provide an adjustable table for work piece	✓	✓	low to med med to high	med med	med med
22. Awkward foot postures	• Work object is too low, causing the foot to bend at the toes for balance	124. Raise the work piece/work surface • provide support for the work piece • provide an adjustable table for work piece	✓	✓	low to med med to high	med med	med med
		132. Remove obstructions • clear boxes and other items off the floor	✓		low	med	med

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	18. Improve visual access to work • light levels should be 50fc to 75fc for work		✓	low to med	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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CASE STUDY – Lubricating	
TASK TITLE: Lubricating	
Task Description:	The Lubricating task is typically one step in routine vehicle maintenance. Lubricating is typically a moderate duration task. Lubricating may be performed on vehicles, (cars, trucks, trailers, etc.) or equipment (sliding doors, carts, etc.). Typical environments in which the Lubricating task may be found can include: • Vehicle Maintenance and Repair • Equipment/Shop Maintenance
Job Performance Measures Most Often Impacted by Lubricating:	Measure of work performance can include (but is not necessarily limited to): • Time to complete task
Typical Employee Comments about Lubricating:	Employees typically experience discomfort in the shoulders. The shoulder/neck is the body area that most commonly receives a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	Postural Analysis, Dynamic Task Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Accessing awkward lubrication points	149. Provide appropriate tools					
		• use long flexible lube gun attachments to promote reaching with the nozzle rather than the whole gun		✓	low	low	med
		• use a pneumatic driven lube gun to reduce time in awkward positions		✓	med	low	high
		38. Move closer to the work location					
		• remove obstructions to lubrication point	✓		low	low	low
		• use a vehicle lift or pit to improve access to lubrication points		✓	high	med	high
		• use a crawler to improve position		✓	low to med	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Rarely occurs	N/A					
3. High speed sudden shoulder movements	• Rarely occurs	N/A					
4. Head/neck bent or twisted	• Accessing awkward lubrication points 	149. Provide appropriate tools					
		• use pneumatic driven lube gun to reduce time in awkward positions		✓	med	low	high
		• use crawlers with adjustable angle head and back supports		✓	med	med	med
		38. Move closer to the work location	✓				
		• remove obstructions to lubrication point, such as wheels and tires		✓	low	low	low
		• use a vehicle lift or pit to improve access to lubrication points			high	med	high
		22. Increase light levels	✓				
		• use adjustable position task lighting to improve visual access			low to med	med	low

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/ repeated wrist movements or repeated forearm rotation	• Accessing awkward lubrication points 	149. Provide appropriate tools					
		• use long flexible lube gun attachments to promote reaching with the nozzle rather than the whole gun, and to promote bending the flexible attachment rather than the wrist		✓	med	low	low
		• use pneumatic driven lube gun to reduce time in awkward positions		✓	med	low	low
		38. Move close to the work location					
		• remove obstructions to lubrication point, such as wheels and tires	✓		low	low	low
		• use a vehicle lift or pit to improve access to lubrication points		✓	high	med	high
		• use a crawler to improve position		✓	low to med	med	med

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Design of gun	149. Provide appropriate tools • provide a gun with multi-finger trigger which does not require hyperextension		✓	med	low	low
8. Hand/grip forces	• Repeatedly squeezing lubrication gun	149. Provide appropriate tools • use pneumatic driven lube gun		✓	med	low	high
9. High speed hand/wrist /arm movement or vibration, impact or torque to the hand	• Rarely occurs	N/A					

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
10. Exposure to hard edges	• Resting the arm against hard edges while reaching to awkward lubrication points	9. Eliminate exposure to hard edges • use high density foam padding for any areas with prolonged contact	✓		low	low	low
		149. Provide appropriate tools • use pneumatic driven lube gun to reduce time in awkward positions		✓	med	low	high
		38. Move closer to the work location • remove obstruction to point	✓		low	low	low
		• use a vehicle lift or pit to improve access to lubrication points		✓	high	med	high
11. Hands and fingers exposed to cold temperatures	• Work area is too cold	12. Encourage appropriate seasonal clothing	✓		low	low	low
		93. Provide appropriate gloves	✓		low	low	low
		23. Increase room temperature		✓	high	low	low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Accessing awkward lubrication points	149. Provide appropriate tools					
		• use long flexible lube gun attachments to promote reaching with the nozzle rather than the whole gun		✓	low	low	med
		• use crawlers with adjustable angle head, back and thigh support		✓	med	med	med
		• use pneumatic driven lube gun to reduce time in awkward positions		✓	med	low	high
		38. Move closer to the work location					
		• remove obstructions to lubrication point	✓		low	low	low
		• use a vehicle lift or pit to improve access to lubrication points		✓	high	med	high
13. Twisting of the lower back	• Accessing awkward lubrication points	149. Provide appropriate tools					
		• use long flexible lube gun attachments to promote reaching with the nozzle rather than the whole gun		✓	low	low	med
		• use crawlers with adjustable angle head, back and thigh support		✓	med	med	med
		• use pneumatic driven lube gun to reduce time in awkward positions		✓	med	low	high

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Accessing awkward lubrication points (continued)	38. Move closer to the work location					
		• remove obstructions to lubrication point	✓		low	low	low
		• use a vehicle lift or pit to improve access to lubrication points		✓	high	med	high
14. High speed sudden movements or lifting awkward, uneven, shifting or bulky items.	• Rarely occurs	N/A					
15. Static, awkward back postures	• Accessing awkward lubrication points	149. Provide appropriate tools					
		• use long flexible lube gun attachments to promote reaching with the nozzle rather than the whole gun		✓	low	low	med
		• use crawlers with adjustable angle head, back and thigh support		✓	med	med	med
		• use pneumatic driven lube gun to reduce time in awkward positions		✓	med	low	high
		38. Move closer to the work location					
		• remove obstructions to lubrication point, such as wheels and tires	✓		low	low	low
		• use a vehicle lift or pit to improve access to lubrication points		✓	high	med	high

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
16. Lifting forces	• Rarely occurs	N/A					
17. Pushing or pulling	• Rarely occurs	N/A					
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position standing	• Rarely occurs	N/A					
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Accessing awkward lubrication points 	9. Eliminate exposure to hard edges • use high density foam padding for any areas with prolonged contract	✓		low	low	low
		149. Provide appropriate tools • use pneumatic driven lube gun to reduce time in awkward positions		✓	med	low	high
		38. Move closer to the work location • remove obstructions to lubrication point	✓		low	low	low
		• use a vehicle lift or pit to improve access to lubrication points		✓	high	med	high
		95. Provide appropriate knee protection		✓	low	low	low

Legs/Feet (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
21. Awkward leg postures	• Accessing awkward lubrication points	9. Eliminate exposure to hard edges • use high density foam padding for any areas with prolonged contract	✓		low	low	low
		149. Provide appropriate tools • use pneumatic driven lube gun to reduce time in awkward positions		✓	med	low	high
		38. Move closer to the work location • remove obstructions to lubrication point	✓		low	low	low
		• use a vehicle lift or pit to improve access to lubrication points		✓	high	med	high
22. Awkward foot postures	• Rarely occurs	N/A					

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Accessing awkward lubrication points	38. Move closer to the work location • remove obstructions to lubrication point • use a vehicle lift or pit to improve access to lubrication points 18. Improve visual access to work • use multi-positional task lighting to improve visual access	 ✓	 ✓ ✓	 low high low to med	 low med med	 low high med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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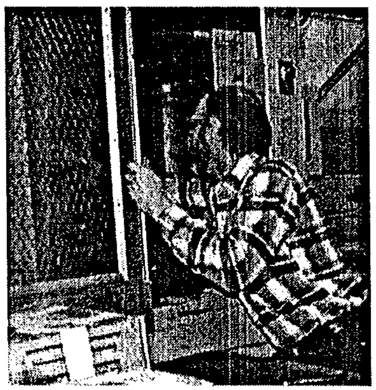
CASE STUDY – Molding	
TASK TITLE: Molding	
Task Description:	The Molding task's purpose is to construct a mold. Mold construction requires completion of different assembly and finishing tasks including: building, grinding, cutting and sanding. Further guidance for each assembly and finishing task can be found in the Maintenance and Inspection (M/I) Guide: Case Study 19 - Grinding, Case Study 4 - Cutting, and Case Study 39 - Sanding. Typical environments in which the molding task may be found can include: • Plastic Molding • Fabricating Parts • Repairing Parts
Job Performance Measures Most Often Impacted by Molding :	Measure of work performance can include (but are not necessarily limited to): • Quality of the repairs and inspections • Number of pieces completed
Typical Employee Comments about Molding:	Employees typically experience discomfort in the hands/wrists/arms, shoulder/neck, and head/eyes. The hands/wrists/arms and shoulder/neck are the body areas that most commonly receive a "High" priority rating. The remaining body areas are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	Biomechanical Lifting Analysis, Push/Pull Force Analysis, Dynamic Task Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Object too high	32. Lower the work piece/work surface					
		• lower the table or object so that the individual is positioned at or just below elbow level when assembling parts or removing parts	✓		low	low	med
		123. Raise the person					
		• provide a platform to raise the person in relation to the object	✓		low to med	low to med	med
		• raise the chair and provide a footrest if the feet are unsupported	✓		low to med	low	med
	• Object too far away	41. Move work piece closer to body					
		• pull the object close to the work surface edge rather than reaching across the surface	✓		low	low	low
		• arrange items on work surface by frequency of use	✓		low	low	low

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Item is too heavy	61. Provide a mechanical lift device		✓	high	high	high
		131. Reduce weight of work piece • reduce the weight of the object by moving individual components separately	✓		low	low	low
		142. Use two or more persons to perform the transfer	✓		low	low	low
	• High forces required to pull down top of molding press or remove plastic from molding machine	128. Reduce force required to install or remove the component • use lubricant where feasible	✓		low	low	med
		• modify design of component mold or subsystem to reduce forces during installation or removal		✓	high	med	med
		• investigate a work procedure to reduce plastic overruns	✓		low	med	high
	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition • repair wheels on carts or equipment	✓		low	low	low
		119. Provide wheels • install appropriate wheels	✓		med	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	med	high
		• repair cracks or gaps in floor	✓		med	med	med
		• provide ramps to compensate for minor differences in floor height		✓	high	med	med
	• Carry distance is more than three steps	126. Reduce carry distance					
		• arrange storage and work areas to reduce travel distances	✓		low	low	med
		67. Provide a powered cart					
		• provide a cart to transport materials		✓	med to high	low	med
		11. Eliminate unnecessary tasks					
		• eliminate or combine handling tasks	✓		low	med	med
		• transport items in larger quantities instead of handling them individually	✓		low	med	med
		37. Modify facilities to decrease handling					
		• widen doors to allow materials to be handled on carts		✓	high	med	med

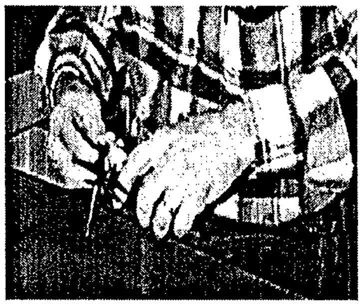
Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements	• Speed of lift	13. Encourage ergonomic work techniques • encourage person to avoid rushing while handling items	✓		low	low	low
	• Item or plastic is stuck in molding machine	128. Reduce force required to install or remove the component • use lubricant where feasible • modify design of component mold or subsystem to reduce forces during installation or removal	✓	✓	low high	med med	med med
4. Head/neck bent or twisted	• Objects positioned flat on work surface or too low 	124. Raise the work piece/work surface • elevate the work piece by raising the table or angling the work piece forward.	✓		med	med	med

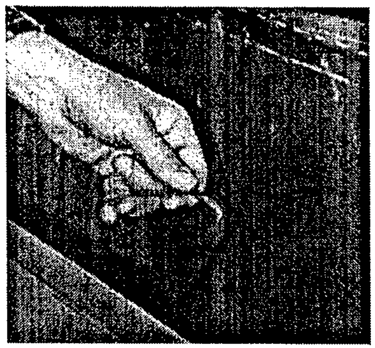
Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Building small plastic molds	20. Incorporate rest pauses		✓	high	high	high
	• Reaching for components located off to one side	41. Move work piece closer to body • place the components directly in front of the individual or next to the individual	✓		low	low	low
		55. Provide a hook type tool to pull items	✓		low	low	low
	• Object too high	32. Lower the work piece/work surface • lower the table or object so that the table is positioned at or just above elbow level when assembling parts or removing parts	✓		low	low	low
		123. Raise the person • provide a platform to raise the person in relation to the object	✓	✓	low to med	low to med	med
		• raise the chair and provide a footrest if the feet are unsupported	✓	✓	low	low	med
		152. Relocate the work • reorient the work to make access easier	✓		low	low	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
6. Repeated manipulations with fingers	• Trimming 	11. Eliminate unnecessary tasks • modify mold to minimize trimming and sanding		✓	med to high	high	high
7. Hyper-extension of finger/thumb or repeated single finger activation	• Using cutters with a wide handle span	149. Provide appropriate tools • provide cutters with a desirable handle span which is usually less than 3"(7.6cm)	✓		med	high	med

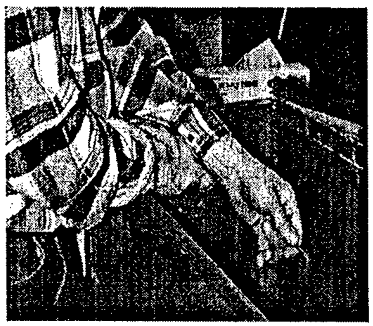
Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
8. Hand/grip forces	• Item is difficult to grasp • Item has no handles • Item is slippery 	149. Provide appropriate tools • provide appropriate tools with features (e.g., handle contour and diameter, grip material) designed to reduce grip forces		✓	high	high	med
	• High force trimming or sanding	11. Eliminate unnecessary tasks • modify mold to minimize trimming and sanding		✓	med to high	high	high

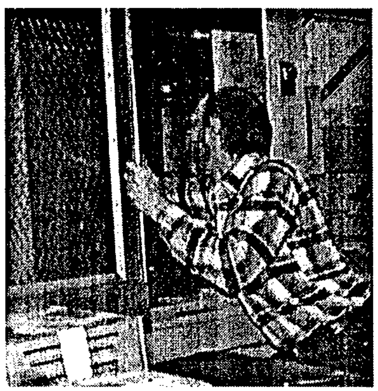
Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• High force trimming or sanding 	11. Eliminate unnecessary tasks • modify mold to minimize trimming and sanding		✓	med to high	high	high
		149. Provide appropriate tools • provide high quality cutting and trimming tools (including clippers and knives) which minimize forces		✓	low to med	low	low
		35. Maintain tracks, rollers, and movement mechanisms • replace blades often	✓		low	low	low
		66. Provide a power tool • provide powered cutting tools for high force tasks		✓	med	low	low
		• use leverage/mechanical advantage (e.g. mechanical presses) to reduce cutting forces	✓		med	low	high

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
10. Exposure to hard edges	• Lifting dipping racks with small narrow handles 	88. Provide an appropriate handle diameter • provide a wrap around the handle so that the diameter is no less than 1-1.5" (2.5-3.8cm)	✓		low	med	med
	• Hard edges on tools	9. Eliminate exposure to hard edges • provide tools with rounded handles	✓		med	low	low
		• wrap or cover hard edges	✓		low	low	low
11. Hands and fingers exposed to cold temperatures	• Rarely occurs	N/A					

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	Level of Changes: ✓ Major Change	Cost	Impact On: Quality	Impact On: Productivity
12. Repeated forward or sideways bending movements	• Object is too low	124. Raise the work piece/work surface					
		• place heaviest items between knuckle and shoulder height (25”-50”) (64-127 cm)	✓		low	low	low
		• provide a fixed table to support work piece		✓	med	med	med
		• provide an adjustable table or scissor lift for work piece		✓	high	med	med
	• Object is too far away	38. Move closer to the work location					
		• remove obstructions	✓		low	low	low
		• modify style of sliding guard to promote increased access	✓		high	low	med
		41. Move work piece closer to body	✓		low	low	low
	• Person tends to use the back to lift instead of using the legs to assist in the lift. Check to make sure that there is no contributing factor in the workplace	13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use leg muscles to lift	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
13. Twisting of the lower back	• Access is restricted to a component that needs to be removed	82. Provide adequate work space • improve access to items stored on shelves	✓		low	med	med
		61. Provide a mechanical lift device • provide mechanical assistance for handling the load		✓	high	med	med
	• Work area layout	130. Reduce the angle a person has to turn to transfer the item • for example, if the transfer involves a 180 degree twist, move the source or destination to reduce the twist to 90 degrees or less	✓		low	low	low
	• Person tends to twist with the back instead of using the legs and feet to pivot	13. Encourage ergonomic work techniques • provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use legs to pivot when handling a load	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
14. High speed, sudden movements or Lifting awkward, uneven, shifting or bulky items.	• Person tends to lift with a jerky motion instead of a smooth motion	13. Encourage ergonomic work techniques • encourage person to use smooth controlled movements while handling items	✓		low	low	low
		147. Provide an alternate container • contact vendor and request re-packing object in container with handles or increasing object density		✓	med	low	low
15. Static, awkward back postures	• Object located too low 	124. Raise the work piece/work surface • place heaviest items between knuckle and shoulder height (25"-50") (64-127 cm)	✓		low	low	med
		• provide a fixed table to support work piece	✓		low	med	med
		• provide an adjustable table or scissors lift for work piece		✓	high	med	med
		38. Move closer to the work location • remove obstructions	✓		low	low	med
		41. Move work piece closer to body	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
15. Static, awkward back postures	• Poor lower back support	52. Provide a footrail or footrest • encourage the person to sit back in chair	✓		low to med	low	low
		87. Provide an appropriate chair/stool • provide a chair which supports lower back		✓	med to high	low	low
		115. Provide support for lower back • adjust back rest • provide a lumbar support pillow	✓ ✓		low low	low low	low low
16. Lifting forces	• Item is too heavy	61. Provide a mechanical lift device		✓	high	med	med
		142. Use two or more persons to perform the transfer	✓		low	low	low
17. Pushing or pulling	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition • repair wheels on carts or equipment	✓		low	low	med
		119. Provide wheels • provide wheels with appropriate bearings and tread composition	✓		low	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition • improve housekeeping • repair cracks or gaps in floor • provide ramps to compensate for minor differences in floor height	 ✓ ✓ 	 ✓	 low low high	 low low med	 med med med
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Standing in one position	52. Provide a footrail or footrest	✓		low to med	low	low
		1. Alternate between sitting and standing tasks	✓		low	low	med
20. Standing on hard surfaces or exposure to hard edges on legs, knees, and feet	• Hard edges on seat pan 	9. Eliminate exposure to hard edges • provide a pillow to sit on to avoid exposure to hard edges on seat	✓		low	low	med
	• Prolonged standing on hard floors	86. Provide an appropriate anti-fatigue mat		✓	med	low	low
21. Awkward leg postures	• Work object is too low	124. Raise the work piece/work surface • provide an adjustable table for work piece		✓	high	med	med
		20. Incorporate rest pauses	✓		low	med	med

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
22. Awkward foot postures	• Lack of foot space	132. Remove obstructions	✓		low	low	low
		80. Provide adequate leg clearance	✓		low to high	low	low

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Low light level due to location of the component	18. Improve visual access to work • light levels should be 75fc to 100fc for work • provide a portable task light that can be moved around the area or clamped onto a support work surface to improve light levels		✓	med	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Work on small components	60. Provide a magnifying glass • provide a magnifying glass that will magnify the work piece - the magnifier should be height, angle and horizontally adjustable		✓	med	med	med

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CASE STUDY - Packing/Shipping

TASK TITLE: Packing/Shipping

Task Description:	The Packing/Shipping task typically involves filling the box with packing materials, taping the box closed, weighing the box, labeling the box and placing the box aside for shipment. The box may be placed in a bin, cart, pallet or conveyor while awaiting shipment. This case study does not address the packing of parachutes or rafts; for information on these topics please refer to the M/I Guide Case Study 33 - Packing. The case study also does not address loading or transporting loads. For information on these related copies, please refer to this W/I Guide Supplement for the following: Loading/Unloading-Case Study 11; Transporting Loads On Non-Powered Carts – Case Study 20; Lifting – Case Study 22. Typical environments in which the Packing/Shipping task may be found can include: • Warehouse
Job Performance Measures Most Often Impacted by Packing/Shipping:	Measure of work performance can include (but are not necessarily limited to): • Number of packages shipped per day • Time to process requests
Typical Employee Comments about Packing/Shipping:	Employees typically experience discomfort in the lower back and shoulders. The back/torso and shoulders/neck are the body area that most commonly receives a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	NIOSH Lifting Equation, Biomechanical Lifting Analysis, Push/Pull Force Analysis

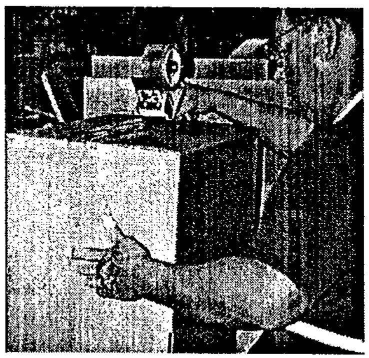
Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Object is too high	32. Lower the work piece/work surface • place heaviest items below shoulder height (50")(127 cm) or less and above knuckle height (25")(64 cm)	✓		low	low	med
	• Object is too far away	38. Move closer to the work location • step closer to load	✓		low	low	low
		41. Move work piece closer to body • slide load to edge before lifting	✓		low	low	low
	• Box is too big	147.Provide alternate container • provide a smaller container (reduce depth, reduce width)		✓	low to high	high	high
		• replace single big container with 2 or 4 smaller containers		✓	low to high	high	high
		• provide a cut-out flap to increase access to box		✓	low to high	high	high
		• provide a box with open or removable sides		✓	low to high	high	high

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Box is at a poor angle	146. Angle the work surface					
		• provide an angled fixture for packing	✓		low	med	med
		• provide a lift and tilt table for packing	✓		med to high	med	med
	• Lifting over flaps of packing box	149. Provide appropriate tools					
		• provide clips to hold flaps out of the way	✓		low to med	med	med
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Applying tape	153. Use desk-based tape dispenser instead of handheld dispensers		✓	low	low	low
	• Operating strapper	149. Provide appropriate tools					
		• provide strapper with a better gearing ratio which requires less force		✓	med	low	med
		35. Maintain tracks, rollers, and movement mechanisms					
		• maintain strappers to reduce forces	✓		low	low	low

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements	• Speed of lift	13. Encourage ergonomic work techniques • encourage person to use smooth fluid movements while handling items	✓		low	low	low
	• Applying tape 	153. Use desk-based tape dispenser instead of handheld dispensers		✓	low	low	low
4. Head/neck bent or twisted	• Scale readout too far away	39. Move monitor/screen closer to body	✓		low	high	low
		45. Position the monitor/screen in front of the body	✓		low	high	low
	• Carton/work is too low	124. Raise the work piece/work surface					
		• provide an adjustable height surface		✓	low to med	med	med
		• provide a riser/fixture for carton to raise up to elbow height	✓		low	med	med

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Carton/work is too low	124. Raise the work piece/work surface					
		• provide an adjustable height surface		✓	low to med	med	med
		• provide a riser/fixture for carton to raise up to elbow height	✓		low	med	med
	• Box is at a poor angle	146. Angle the work surface					
		• provide an angled fixture for packing	✓		low	med	med
		• provide a lift and tilt table for packing		✓	med to high	med	med
	• Lifting over flaps of packing box	149. Provide appropriate tools					
		• provide clips to hold flaps out of the way	✓		low to med	med	med
	• Shape of grasping location (handle) on work piece causes awkward wrist positions	94. Provide appropriate handles					
		• provide handles which pivot slightly to permit a straight wrist during handling		✓	med	low	low
		• provide cut-outs on boxes or containers		✓	low to high	high	high

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Work method: flip folding boxes causes high speed wrist movements	13. Encourage ergonomic work techniques • fold the box open rather than flipping it open	✓		low	low	low
	• Applying tape	153. Use desk-based tape dispenser instead of handheld dispensers		✓	low	low	low
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Handling awkwardly shaped items	147. Provide an alternate container • provide a smaller container • provide a more stable container		✓ ✓	low to med low to med	med med	med med
		94. Provide appropriate handles		✓	med	med	med
		61. Provide a mechanical lift device		✓	med	med	low
	• Operating strapper with one hand	148. Provide appropriate equipment • provide a strapper that allows two-handed use		✓	low to med	low	low
8. Hand/grip forces	• Item is difficult to grasp • Item is slippery	147. Provide an alternate container • provide a smaller container • provide a more stable container		✓ ✓	low to med med	med med	med med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Applying tape 	153. Use desk-based tape dispenser instead of handheld dispensers		✓	low	low	low
10. Exposure to hard edges	• Item has small handles	88. Provide an appropriate handle diameter	✓		low to med	low	low
	• Handles have hard edges	94. Provide appropriate handles • provide rounded slightly compressible handles		✓	low to med	low	low
		61. Provide a mechanical lift device		✓	med to high	med	med
11. Hands and fingers exposed to cold temperatures	• Work area is too cold	12. Encourage appropriate seasonal clothing	✓		low to med	med	med
		93. Provide appropriate gloves	✓		low to med	med	low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Object is too low 	124. Raise the work piece/work surface					
		• place heaviest items between mid thigh and shoulder height	✓		low	med	med
		• provide a fixed table to support work piece		✓	med	med	med
		• provide an adjustable table		✓	med to high	med	med
	• Object is too far away	41. Move closer to the work location					
		• step closer to load	✓		low	med	low
		• slide load to edge before lifting	✓		low	med	low
		46. Provide a ball-bearing rotation table		✓	med to high	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Lifting item out of a deep container causes awkward bending	147. Provide an alternate container					
		• use a smaller container		✓	med to high	med	med
		• use a container with drop down sides		✓	med to high	med	med
		• use a pallet instead of a bin		✓	med to high	med	med
	• Person tends to use the back to lift instead of using the legs to assist in the lift (check to make sure that there is no contributing factor in the workplace)	13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use leg muscles to lift	✓		low	low	low
	• Same object is lifted repeatedly throughout the shipping process	11. Eliminate unnecessary tasks					
		• install a scale in the work surface or conveyor		✓	med to high	med	high
		• use conveyors to move boxes		✓	med to high	med	high
13. Twisting of the lower back	• Work area layout	130. Reduce the angle a person has to turn to transfer the item					
		• for example, if the transfer involves a 180 degree twist, move the source or destination to reduce the twist to 90 degrees or less	✓		low to high	low	med
		• reposition supplies/materials to reduce twisting	✓		high to low	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Person tends to twist with the back instead of using the legs and feet to pivot	150. Redesign the workspace • place containers and surfaces so twisting is avoided	✓		low	low	low
		13. Encourage ergonomic work techniques • provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use legs to pivot when handling a load	✓		low	low	low
14. High speed, sudden movements or Lifting awkward, uneven, shifting or bulky items.	• Item is bulky, awkward and/or shifts easily	61. Provide a mechanical lift device		✓	med to high	med	med
	• Person tends to lift with a jerky motion instead of a smooth motion	13. Encourage ergonomic work techniques • encourage person to use smooth fluid movements while handling items	✓		low	low	low
15. Static, awkward back postures	• Packing location is too low (table height too low or filling box which is on the floor)	124. Raise the work piece/work surface • raise the table to allow packing between waist and elbow height		✓	med	med	med
		• provide a packing table		✓	med	med	med
		• use an adjustable height packing table		✓	med	med	med
16. Lifting forces	• Item is too heavy	61. Provide a mechanical lift device		✓	med	med	low
		142. Use two or more persons to perform the transfer	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	• Pushing a box on the floor to a cart, pallet or holding area	11. Eliminate unnecessary tasks • Bring a cart to the box to load at the packing point	✓		low	low	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition • improve housekeeping • repair cracks or gaps in floor	✓ ✓		low low	med med	med med
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes ✓ Minor Modification	✓ Major Change	Cost	Impact On: Quality	Productivity
19. Fixed position, standing	• Standing in one position	25. Increase task variety	✓		low	med	low
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Leaning against bin during loading	9. Eliminate exposure to hard edges	✓		med	low	low
		147. Provide an alternate container					
		• use a smaller container	✓		low to med	low	med
		• use a container with drop down sides		✓	med to high	low	low
		• use a pallet instead of a bin	✓		low	low	low
		96. Provide appropriate shoe inserts	✓		med	low	low
	• Standing on hard surface	86. Provide an appropriate anti-fatigue mat		✓	med	low	low
21. Awkward leg postures	• Work object is too low	124. Raise the work piece/work surface					
		• provide support for the work piece	✓		low to med	med	med
		• provide an adjustable table for work piece		✓	med to high	med	med
22. Awkward foot postures	• Rarely occurs	N/A					

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	18. Improve visual access to work • Light level should be 50fc to 75fc for the work		✓	low to high	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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CASE STUDY – Palletizing

TASK TITLE: Palletizing	
Task Description:	The Palletizing task occurs primarily in the warehouse environment and is typically performed to prepare a load for delivery to a specified location. The task usually involves consolidation, that is, taking individual items from carts or various pallet stacks and placing them on a centralized pallet according to the specifications of the requesting location. After the items are placed on the centralized pallet, the pallet is secured (by shrink-wrap, straps or other means) and delivered by fork truck to the desired location. Items that are too heavy to move manually are loaded onto the pallet by fork truck (Note: Refer to Fork Truck Operating (sitting) Case Study 8, for additional information since the use of fork trucks will not be discussed here.) Typical examples in which the Palletizing tasks can occur include (but are not limited to) are: • Load consolidation • Pallet build-up/tie-down • Packing mail into tri-wall containers.
Job Performance Measures Most Often Impacted by Palletizing:	Measures of work performance can include (but are not necessarily limited to): • Load stability/material integrity • Number of loads assembled/distributed per day
Typical Employee Comments about Palletizing:	Employees experience discomfort in the back/torso, shoulders, and wrists. The back/torso and shoulder are the body areas that most commonly receive a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive "Medium" priority rating, or lower.
Suggested Level II Analysis:	Dynamic task Analysis, Grip Force Measurement (for jobs using tie-down straps), Biomechanical Lifting Analysis, NIOSH Lifting Equation

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Material is too low	124. Raise the work piece/work surface					
		• place empty pallets under the active pallet to increase the height during loading/unloading	✓		low	low	low
		• provide a lift table to elevate the active pallet		✓	high	low	med
	• Material is too far from the edge of the pallet	38. Move closer to the work location	✓				
		• provide unobstructed access to at least three, preferably four sides of the pallet			low	low	med
		13. Encourage ergonomic work technique	✓				
		• encourage person to walk around pallet			low	low	low
		41. Move work piece closer to body					
		• provide a turntable for the pallet		✓	med	low	med
		127. Reduce depth of storage container					
		• provide tri-wall containers with removable sides to allow better access		✓	med	low	med
		• provide containers with drop down flaps		✓	med	low	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Material is too high during placement of tie-down nets	83. Provide an adjustable height lift table					
		• use pits to lower the pallet during positioning of the netting over the load		✓	high	low	high
		62. Provide a mechanical lift device					
		• use a fork truck and rack to position netting over large loads		✓	med	low	high
	• Shrink wrapping	149. Provide appropriate tools					
		• provide a height adjustable table for shrink wrapping		✓	med	low	med
2. Arm forces: Repeated arm forces or holding/ Carrying materials	• Transferring heavy loads	61. Provide a mechanical lift device					
		• use a fork truck to lift and place heavy items	✓		low	low	med
		• provide a hoist or other lifting device to lift and place heavy loads		✓	med to high	low	med
	• Operating strapper	149. Provide appropriate tools					
		• provide strapper with a better gearing ratio which requires less force		✓	med	low	med
		34. Maintain hand tool/power tools					
		• maintain strappers to reduce forces	✓		low	low	low

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	Level of Changes: ✓ Major Change	Cost	Impact On: Quality	Impact On: Productivity
	• Obtaining tangled tie-downs from containers can require repeated forceful exertions	147. Provide an alternate container • after use in the field, fold tie downs in a pattern which minimizes tangling	✓		low	low	med
		• provide a rack for hanging tie-downs after use to eliminate tangling		✓	med	low	med
		11. Eliminate unnecessary tasks • eliminate the use of tie-down netting; use shrink wrap		✓	high	low	high
3. High speed, sudden shoulder movements	• Tightening tie-downs can require excessive force and jerking motions	147. Provide appropriate tools • provide tie-downs that are equipped with a ratcheting mechanism – eliminate excessive pulling force for tightening		✓	med	med	high
	• Obtaining tangled tie-downs from containers can require repeated forceful exertions	148. Provide an alternate container • after use in the field, fold tie downs in a pattern which minimizes tangling	✓		low	low	med
		• provide a rack for hanging tie-downs after use to eliminate tangling		✓	med	low	med
		11. Eliminate unnecessary tasks • eliminate the use of tie-down netting; use shrink wrap		✓	high	low	high

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements (cont'd)	• Operating strapper	149. Provide appropriate tools • provide strapper with a better gearing ratio which requires less force		✓	med	low	med
		34. Maintain hand tool/power tools • maintain strappers to reduce forces	✓		low	low	low
	• Material is too high during placement of tie-down nets	32. Lower the work piece/work surface • use pits to lower the pallet during positioning of the netting over the load		✓	high	low	high
		61. Provide a mechanical lift device • use a fork truck and rack to position netting over large loads		✓	med	low	high
		13. Encourage ergonomic work techniques	✓		low	low	low
4. Head/neck bent or twisted	• Inadequate headroom	82. Provide adequate workspace • move palletizing area to where there is adequate head clearance	✓	✓	low to high	low	med

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Repeated handling of multiple items/boxes	11. Eliminate unnecessary tasks					
		• investigate possibility of providing full pallet load of certain items and handling with a fork truck	✓		low	low	med
		• whenever possible, load pallet in the opposite order of delivery needs (i.e., first item on is last item off) to avoid re-handling	✓		low	low	low
	• One handed manual shrink wrapper	149. Provide appropriate tools					
		• provide two-handed manual shrink wrapper		✓	med	low	med
		• provide an automatic shrink wrapper		✓	high	med	high
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Awkward containers	147. Provide an alternative container					
		• provide a smaller container		✓	med	med	med
		• provide a more stable container	✓		med	med	med
		94. Provide appropriate handles		✓	med	med	med
		61. Provide a mechanical lift device		✓	med	med	low

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
8. Hand/grip forces	• Tightening tie-downs can require excessive force of the hands	149. Provide appropriate tools • provide tie-downs that are equipped with a ratcheting mechanism to eliminate excessive pulling force when tightening		✓	med	med	high
	• Operating strapper	149. Provide appropriate tools • provide strapper with a better gearing ratio which requires less force		✓	med	low	med
		34. Maintain hand tool/power tools • maintain strappers to reduce forces	✓		low	low	low
	• One handed manual shrink wrapper	149. Provide appropriate tools • provide two-handed manual shrink wrapper		✓	med	low	med
		• provide an automatic shrink wrapper		✓	high	med	high

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Operating strapper	149. Provide appropriate tools • provide strapper with a better gearing ratio which requires less force		✓	med	low	med
		34. Maintain hand tool/power tools • maintain strappers to reduce forces	✓		low	low	low
10. Exposure to hard edges	• Handling products with hard edges	93. Provide appropriate gloves	✓		low to med	low	low
11. Hands and fingers exposed to cold temperatures	• Work area is too cold	23. Increase room temperature • encourage employees to keep doors shut	✓		low	low	low
		93. Provide appropriate gloves • provide thin gloves with high friction surface (e.g., rubber dots)	✓		low	low	low
		12. Encourage appropriate seasonal clothing	✓		low	low	low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Material is too low	124. Raise the work piece/work surface					
		• place empty pallets under the active pallet to increase the height during loading/unloading	✓		low	low	low
		• provide a lift table to elevate the active pallet		✓	high	low	med
	• Material is too far from the edge of the pallet	38. Move closer to the work location.					
		• provide unobstructed access to at least three, preferably four sides of the pallet	✓		low	low	med
		127. Reduce depth of storage container					
		• provide containers (tri-wall) with removable sides to allow better access		✓	med	low	med
		• provide containers with drop down flaps		✓	med	low	med
	• Shrink wrapping	124. Raise the work piece/work surface					
		• provide a height adjustable table for shrink wrapping		✓	med	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Obtaining tangled tie-downs from containers can require repeated bending	147. Provide an alternate container • provide containers that have a side latched spring	✓		low	low	med
		• provide a rack for hanging tie-downs after use to eliminate tangling		✓	med	low	med
		11. Eliminate unnecessary tasks • reduce the use of tie-down netting; use shrink wrap whenever feasible		✓	high	low	high
		146. Angle the work surface • tilt the container for easier access		✓	med	low	med
13. Twisting of the lower back	• Inappropriate positioning of pallets may increase twisting	82. Provide adequate work space • place enough space between pallets so that employee is required to turn the entire body and take a step, rather than twist the back	✓		low	low	low
	• Access to all sides of pallet is limited • Person tends to twist with the back instead of using the legs and feet to pivot	38. Move closer to the work location. • provide unobstructed access to at least three, preferably four side of the pallet	✓		low	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
		146. Angle the worksurface • tilt the container for easier access	✓		low	low	low
		13. Encourage ergonomic work techniques • provide training on ergonomics principles and materials handling techniques	✓		low	low	low
		• encourage person to use legs to pivot while transferring loads or loading/unloading pallets	✓		low	low	low
14. High speed, sudden movements or lifting awkward, uneven, shifting, or bulky items.	• Manual handling of large, bulky items	61. Provide a mechanical lift device • provide a hoist or other lifting device for handling large items		✓	high	low	low
	• Tightening tie-downs can require excessive force and jerking motions	149. Provide appropriate tools • provide tie-downs that are equipped with a ratcheting mechanism – minimize excessive pulling force for tightening		✓	med	med	high
	• Obtaining tangled tie-downs from containers can require repeated forceful exertions	• provide a rack for hanging tie-downs after use to eliminate tangling		✓	med	low	med
		11. Eliminate unnecessary tasks • eliminate the use of tie-down netting; use shrink wrap		✓	high	low	high

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Throwing tie-down netting over tall loads creates uneven force in the back	13. Encourage ergonomic work techniques	✓		low	low	low
		61. Provide a mechanical lift device • use a fork truck to lift and position netting over the load		✓	med	low	med
		• provide a special portable rack for positioning the netting over the load		✓	med	med	med
	• Operating strapper	149. Provide appropriate tools • provide strapper with a better gearing ratio which requires less force		✓	med	low	med
		34. Maintain hand tool/power tools • maintain strappers to reduce forces	✓		low	low	low
15. Static, awkward back postures	• One handed manual shrink wrapper	149. Provide appropriate tools • provide an automatic shrink wrapper		✓	high	med	high

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
16. Lifting forces	• Item(s) being transferred between pallets are too heavy	61. Provide a mechanical lift device					
		• use a hoist to perform the lift		✓	high	low	low
		• use a portable pneumatic scissor jack; position the height of the jack so the operator can slide rather than lift the item between pallets		✓	high	low	low
	• Inappropriate manual handling of pallets	61. Provide a mechanical lift device					
		• use a fork truck to move and position empty pallets	✓		low	low	low
		13. Encourage ergonomic work techniques					
		• consider storing pallets on sides as opposed to flat if handled manually	✓		low	low	low
		• avoid throwing pallets on top of stacks	✓		low	low	low
		142. Use two or more persons to perform the transfer	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	• Tightening tie-downs can require excessive pulling forces	149. Provide appropriate tools • provide tie-downs that are equipped with a ratcheting mechanism; eliminate excessive pulling force for tightening		✓	med	med	high
	• Obtaining tangled tie-downs from containers can require repeated forceful pulling efforts	147. Provide an alternate container • after use in the field, fold tie downs in a pattern which minimizes tangling	✓		low	low	med
		• provide a rack for hanging tie-downs after use to eliminate tangling		✓	med	low	med
		11. Eliminate unnecessary tasks		✓	high	low	high
		• reduce the use of tie-down netting; use shrink wrap whenever feasible	✓		low	low	low
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Rarely occurs	N/A					
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Material is too low, some kneeling on pallets or items may create contact stress to the knees	124. Raise the work piece/work surface					
		• place empty pallets under the active pallet to increase the height during loading/unloading	✓		low	low	low
		• provide a lift table to elevate the active pallet		✓	high	low	low
		9. Eliminate exposure to hard edges					
		• cover any sharp edges with padding if kneeling must occur	✓		low	low	low
		• provide knee pads if kneeling must occur		✓	med	low	low
	• Standing or walking on a hard surface	96. Provide appropriate shoe inserts	✓		low to med	low	low
21. Awkward leg postures	• Material is too low/some squatting may be required	124. Raise the work piece/work surface					
		• place empty pallets under the active pallet to increase the height during loading/unloading	✓		low	low	low
		• provide a lift table to elevate the active pallet		✓	high	low	low

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
22. Awkward foot postures	• Work too low	124. Raise the work piece/work surface					
		• place empty pallets under the active pallet to increase the height during loading/unloading	✓		low	low	low
		• provide a lift table to elevate active pallet		✓	high	low	low

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see, light levels too low or too high	• Rarely occurs	18. Improve visual access to work • Light levels should be 20fc to 50fc for work		✓	low to high	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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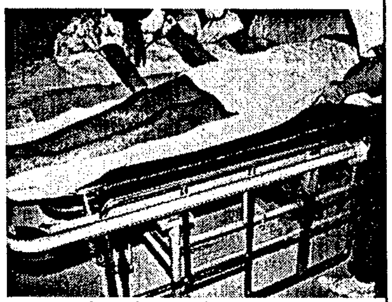
CASE STUDY – Patient Handling	
TASK TITLE: Patient Handling	
Task Description:	The Patient Handling task can occur during medical procedures, patient care on the ward or in outpatient clinics. Patient handling can include transferring the patient from one surface to another, turning and repositioning a patient in a chair or bed, and holding a patient while grooming them. A person performing patient handling can work unassisted or assisted by another person or can use a mechanical lifting device. Patient handling can occur in the following locations: • Hospital • Medical Clinic • Dental Clinic
Job Performance Measures Most Often Impacted by Patient Handling:	Measures of work performance can include (but are not necessarily limited to): • Quality of the patient transfer • Patient safety and comfort • Efficiency of patient transfer (time required to complete transfer)
Typical Employee Comments about Patient Handling:	Employees typically experience discomfort in the back/torso and legs/feet. The back/torso and legs/feet are the body areas that most commonly receive a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	Biomechanical Lifting Analysis, Push/Pull Force Analysis

Note: For patent handling tasks, proper ergonomic work techniques include both the body motions used by the employee and the instructions provided to the patient. Many patients can be educated to assist the employee in performing the transfer. This education generally focuses on methods that have patients use their legs to assist with the movement. It is important for the employee to communicate clearly with the patient so that the efforts are coordinated.

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Bed-Stretcher transfer: draw sheet not wide enough 	149. Provide appropriate tools • provide a draw sheet wide enough to overlap stretcher and eliminate the need to reach and bend	✓		low	med	med
	• Patient is too far away	38. Move closer to the work location • stand closer to the patient when repositioning or transferring the patient	✓		low	med	med
		• use a draw sheet to turn the patient	✓		low	med	med
		132. Remove obstructions • move wheel chairs, commodes, and stretchers close the bed prior to transferring the patient	✓		low	med	med
		42. Obtain patient's assistance • ask the patient to move closer to the edge before handling the patient	✓		low	med	med

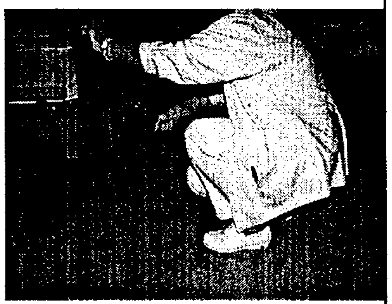
Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Obstruction restricts smooth movement across	132. Remove obstructions • ensure person removes foot supports or moves foot supports out of the way when transferring and repositioning the patient in the wheelchair	✓		low	med	med
		• ensure person removes armrest that is closest to the bed to provide a clear path to transfer the patient	✓		low	med	med
		148. Provide appropriate equipment • provide wheelchairs and commodes that have removable armrests and footrests		✓	med	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Patient is too heavy	61. Provide a mechanical lift device		✓	high	med	med
		142.Use two or more persons to perform the transfer	✓		low	med	med
	• Bed-Stretcher transfer: high friction surface	4. Change lifting/carrying task into a rolling or sliding task • provide a sliding board		✓	low to med	med	med
		11. Eliminate unnecessary tasks • try to reduce unnecessary transfers by using platform scales and examining the work procedure	✓		low	low	low
	• Reposition patient on bed	4. Change a lifting/carrying task into a rolling or sliding task		✓	low to med	med	med
		• provide a sliding board	✓		low	med	med
		142.Use two or more persons to perform the transfer		✓	high	med	med
	• Patient rigid or unable to assist.	61. Provide a mechanical lift device	✓		low	med	med
		142.Use two or more persons to perform the transfer		✓	high	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Manual bed adjustments (crank) 	61. Provide a mechanical lift device • provide power adjustments for bed		✓	high	high	high
	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition • repair wheels on carts or equipment	✓		low	med	med
		119. Provide wheels • install appropriate wheels	✓		med	med	med
	• Stretcher is too heavy to be pushed manually	148. Provide appropriate equipment • provide a stretcher or mechanical-lifting device that is lighter in weight and easier to push		✓	high	med	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition • improve housekeeping • repair cracks or gaps in floor • provide ramps to compensate for minor differences in floor height	 ✓ ✓ 	 ✓	 low high med	 med med med	 med med med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Carry distance is more than three steps	126. Reduce carry distance					
		• position frequently used equipment next to patient	✓		low	med	med
		48. Provide a cart					
		• place infants in bassinets to transport around area or between rooms	✓		low	med	med
		• provide a cart to transport equipment and materials		✓	high	med	med
		• use IV poles to carry patient equipment while moving and transporting patient	✓		low	med	med
		• attach IV poles to stretchers/ carts/wheel chairs when possible	✓		low to med	high	high
		37. Modify facilities to decrease handling					
		• widen doors to allow stretchers and wheelchairs to be moved into bathrooms and patient rooms		✓	high	high	high

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements	• Speed of lift	13. Encourage ergonomic work techniques					
		• encourage person to use smooth fluid movements while handling patient or equipment	✓		low	low	low
		42. Obtain patient's assistance	✓		low	med	med
		61. Provide a mechanical lift device • use a lift device for handling dependent patients		✓	med	med	med
	• Item is stuck in location or difficult to move	128. Reduce force required to install or remove the component					
		• use lubricant to maintain cranks on beds	✓		low	med	med
		• ensure wheelchair components such as footrests and armrests and bed components are maintained.	✓		med	med	med
		• modify the design of wheelchair components such as armrests and footrests to reduce forces during installation or removal		✓	high	high	high
		148. Provide appropriate equipment • provide electric beds where feasible		✓	high	high	high

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
4. Head/neck bent or twisted	• Patient too low	123.Raise the person					
		• raise the bed or stretcher to elbow height	✓		low	low	low
		• raise the head of the bed so the patient is upright or elevated	✓		low	low	low

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Patient is difficult to grasp due to - patient pain - medical condition	94. Provide appropriate handles • provide a transfer belt - position belt around the patient when repositioning patient in chair, transferring or walking with patient. Handles should be rounded and 1-1½" (2.5-3.8cm) in diameter • use draw sheet to reposition patient while in bed or on the stretcher	✓ ✓		low low	low low	low low
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Rarely occurs	N/A					

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
8. Hand/grip forces	• Patient is difficult to grasp due to - patient pain - medical condition	94. Provide appropriate handles • provide a transfer belt and position belt around the patient when repositioning patient in chair, transferring or walking with patient. Handles should be rounded and 1-1½" (2.5-3.8cm) in diameter	✓		low	low	low
		• use draw sheet to reposition the patient while in bed or on the stretcher. Roll up edge of draw sheet to form handle	✓		low	low	low
		13. Encourage work ergonomic work techniques • ensure patient is dry prior to moving or transferring the patient - dry patient in bath or commode chair	✓		low	low	low
		61. Provide a mechanical lift device • use a mechanical lifting aid to remove patient from bath		✓	high	med	med
	• Bed-Stretcher transfer: high friction surface	4. Change lifting/carrying task into a rolling or sliding task • provide a sliding board		✓	low to med	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Speed of lift	13. Encourage ergonomic work techniques					
		• encourage person to use smooth fluid movements while handling patient or equipment	✓		low	low	low
		61. Provide a mechanical lift device					
		• use a lift device for handling dependent patients		✓	med to high	med	med
	• Item is stuck in location or difficult to move	128. Reduce force required to install or remove the component					
		• use lubricant to maintain cranks on beds	✓		low	med	med
		• ensure wheelchair components such as footrests and armrests and bed components are maintained.	✓		med	med	med
		• modify the design of wheelchair components such as armrests and footrests to reduce forces during installation or removal		✓	high	high	high
		148. Provide appropriate equipment					
		• provide electric beds where feasible		✓	high	high	high

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
10. Exposure to hard edges	• Exposed edges on lifting equipment	9. Eliminate exposure to hard edges • cover or wrap hard edges	✓		low	low	low
		148. Provide appropriate equipment • provide equipment without exposed hard edges		✓	med to high	low	low
11. Hands and fingers exposed to cold temperatures	• Rarely occurs	N/A					

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Patient is too low	123. Raise the person					
		• raise the bed or stretcher to just below elbow height when repositioning or transferring the patient	✓		low	low	low
		• raise the head of the bed to elevate the patient into an upright position	✓		low	low	low
	• Patient is too far away	38. Move closer to the work location • move the patient closer to the edge of the bed	✓		low	low	low
		132. Remove obstructions	✓		low	low	low
	• Bed-Stretcher transfer: draw sheet not wide enough	149.Provide appropriate tools • provide a draw sheet wide enough to overlap stretcher and eliminate the need to reach and bend	✓		low	med	med
	• Manual transfer of patient	61. Provide a mechanical lift device		✓	med to high	med	med
		13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use leg muscles to lift	✓		low	low	low
		42. Obtain patient's assistance	✓		low	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	✓ Major Change	Cost	Impact On: Quality	Productivity
13. Twisting of the lower back	• Access to the patient (who needs to be handled) is restricted	82. Provide adequate work space					
		• remove furniture and equipment that may restrict access to the patient	✓		low	low	low
		61. Provide a mechanical lift device					
		• provide mechanical assistance for handling the patient		✓	high	med	med
		• use lift devices which transport patients in an upright posture		✓	high	high	med
	• Person tends to twist with the back instead of using the legs and feet to pivot	13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use legs to pivot when handling a load	✓		low	low	low
14. High speed, sudden movements or Lifting awkward, uneven, shifting or bulky items.	• Bed-Stretcher transfer: draw sheet not wide enough	149. Provide appropriate tools					
		• provide a draw sheet wide enough to overlap stretcher and eliminate the need to reach and bend	✓		low	med	med
	• Manual transfer of patient between bed-wheel chair or wheel chair-toilet	61. Provide a mechanical lift device		✓	med to high	med	med
		142. Use two or more persons to perform the transfer	✓		low	low	low
		42. Obtain patient's assistance	✓		low	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Item is stuck in location • Item is difficult to install or remove	128. Reduce force required to install or remove component • use lubricant to maintain cranks on beds	✓		low	med	med
		35. Maintain tracks, rollers, and movement mechanisms. • ensure wheelchair components such as footrests and armrests, and bed components are maintained		✓	high	med	med
		• modify design of wheelchair components such as armrests and footrests to reduce forces during installation or removal		✓	high	med	med
		148. Provide appropriate equipment • provide electric beds where feasible		✓	high	med	med
	• Person tends to lift with a jerky motion instead of a smooth motion • Person loses control of the patient	13. Encourage ergonomic work techniques • encourage person to use smooth fluid motions when transferring patient	✓		low	low	low
		• encourage person to slowly lower the individual to the floor surface rather than trying to regain control if the patient falls	✓		low	low	low
		42. Obtain patient's assistance	✓		low	med	med

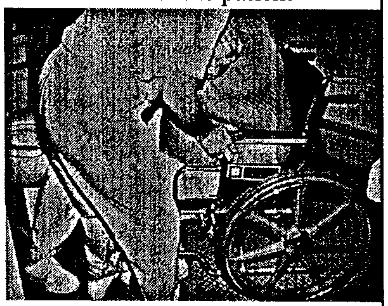
Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
15. Static, awkward back postures	• Patient positioned too low	123.Raise the person • raise the bed or stretcher to just below elbow height when repositioning or transferring the patient	✓		low	low	low
		• raise the head of the bed to elevate the patient into an upright position	✓		low	low	low
16. Lifting forces	• Patient too heavy	61. Provide a mechanical lift device		✓	high	med	med
		142.Use two or more persons to perform the transfer	✓		low	med	med
		11. Eliminate unnecessary tasks • try to reduce unnecessary transfers by using platform scales and examining the work procedure	✓		low	low	low
	• Bed-Stretcher transfer: high friction surface	4. Change lifting/carrying task into a rolling or sliding task • provide a sliding board		✓	low to med	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Patient is difficult to grasp due to - patient pain - medical condition	94. Provide appropriate handles • provide a transfer belt and position belt around the patient when repositioning patient in chair, transferring or walking with patient. Handles should be rounded and 1-1½" (2.5-3.8cm) in diameter	✓		low	low	low
		• use draw sheet to reposition the patient while in bed or on the stretcher. Roll up edge of draw sheet to form handle	✓		low	low	low
		13. Encourage ergonomic work techniques • ensure patient is dry prior to moving or transferring the patient - dry patient in bath or commode chair	✓		low	low	low
		61. Provide a mechanical lift device • use a mechanical lifting aid to remove patient from bath		✓	high	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• High forces are required to lift or lower the patient 	35. Maintain tracks, rollers, and movement mechanisms • ensure wheelchair components such as footrests and armrests, and bed components are maintained	✓		low	low	low
		148. Provide appropriate equipment • provide electric beds where feasible	✓	✓	high	med	med
		• modify the design of wheelchair components such as armrests, and footrests to reduce forces during installation or removal		✓	high	med	med
		42. Obtain patient's assistance	✓		low	low	low
		61. Provide a mechanical lift device		✓	high	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	• Bed-Stretcher transfer: high friction surface	4. Change lifting/carrying task into a rolling or sliding task • provide a sliding board		✓	low to med	med	med
	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition • repair wheels on chairs, stretchers, etc.	✓		low	low	low
		119. Provide wheels • provide wheels with appropriate bearings and tread composition	✓		med	med	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition • improve housekeeping • repair cracks or gaps in floor • provide ramps to compensate for minor differences in floor height	 ✓ ✓ 	 ✓	 low high low	 med med med	 med med med
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Standing for long periods	20. Incorporate rest pauses	✓		low	low	low
		25. Increase task variety • alternate work tasks to avoid handling patients for extended periods of time	✓		low	low	low
20. Exposure to hard edges on legs, knees, and feet o Standing on hard surfaces	• Standing on a hard surface	96. Provide appropriate shoe inserts	✓		low	low	low
21. Awkward leg postures	• Patient is too low	124. Raise the work piece /work surface • raise the bed or stretcher so that the patient is at or just below elbow height	✓		low	med	med
22. Awkward foot postures	• Repeated crouching • Work too low • Manual bed adjustment (crank)	148. Provide appropriate equipment • provide electric beds where feasible		✓	high	high	high

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	18. Improve visual access to work • Light levels should be 100fc to 150fc for work		✓	low to high	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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CASE STUDY – Picking/Stocking	
TASK TITLE: Picking/Stocking	
Task Description:	The Picking/Stocking task involves the placement and retrieval of items for storage areas. These storage areas are typically shelves or carousels. This can include storing small items inside bins, as well as larger boxes on pallets. In some cases the Picking/Stocking tasks are performed using a standing fork truck. In these cases the Fork Truck Standing Case Study should be referenced as well. Typical areas in which the Picking/Stocking task may be found can include: • Logistics • CE Warehouse • Commissary Warehouse
Job Performance Measures Most Often Impacted by Picking/Stocking:	Measure of work performance can include (not necessarily limited to): • Orders filled per day
Typical Employee Comments about Picking/Stocking:	Employees typically experience discomfort in the lower or middle back, attributed to lifting. The back/torso is the body area that most commonly receives a “High” priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive “Medium” priority rating, or lower.
Suggested Level II Analysis:	NIOSH Lifting Equation, Biomechanical Lifting Analysis, Grip Force Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Object too high	32. Lower the work piece/work surface					
		• place the heaviest items between shoulder height (50 in.)(127 cm) and knuckle height (25 in.)(64 cm)	✓		low	low	low
		• place the most frequently accessed items on middle shelves of storage racks	✓		low	med	med
		123. Raise the person • use a standing fork truck or portable stairs to access items stored above shoulder height	✓	✓	low to med	med	low
	• Object is too far away	38. Move closer to the work location • step into the rack when possible	✓		low	low	low
		41. Move work piece closer to body	✓		low	low	low
		• reposition stock on the close side of the pallet	✓		low	low	low
		55. Provide a hook-type tool to pull items		✓	med	med	med
		127. Reduce depth of storage container • reduce depth of stock placed on pallets in the pick tunnel		✓	med	low	low

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Item is too heavy	61. Provide a mechanical lift device		✓	med	low	low
		4. Change a lifting/carrying task into a rolling or sliding task • use a height adjustable cart to retrieve and deliver objects – the operator can slide objects rather than lift	✓	✓	low to med	med	med
		142. Use two or more persons to perform the transfer	✓		low	low	low
		131. Reduce weight of work piece • reduce number of items lifted at same time	✓	✓	low to high	low	low
		37. Modify facilities to decrease handling • install an automated retrieval storage system (AR/RS) or mechanized (carousel) picking/stocking system		✓	high	med	high
	• Item is stuck or wedged in place	13. Encourage ergonomic work techniques • take time to remove obstacles interfering with movement rather than trying to "force the object free	✓		low	low	low
		55. Provide a hook-type tool to pull items		✓	med	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Rolling/sliding resistance of cart causes high forces	119. Provide wheels		✓	med	low	med
		19. Improve wheel condition • repair wheels on carts or equipment	✓		low to med	low	high
	• Pulling object across shelf results in high forces	37. Modify facilities to decrease handling • use flow racks to cue items to the front of a storage rack		✓	high	low	high
		131. Reduce weight of work piece • reduce number of items or weight of items on cart	✓		low	low	low
	• Cart or piece of equipment is too heavy to be pushed manually	67. Provide a powered cart • provide a powered cart or have the object moved by using a fork truck		✓	high	low	high
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition • improve housekeeping	✓		low	med	med
		• repair cracks or gaps in floor	✓		med to high	med	med
		• provide ramps to compensate for minor differences in floor height		✓	med to high	low	low

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Carry distance is more than three steps	37. Modify facilities to decrease handling • arrange storage and work areas in a hub configuration to reduce travel distance		✓	high	low	high
3. High speed, sudden shoulder movements	• Speed of lift	55. Provide a hook-type tool to pull items		✓	med	med	med
		13. Encourage ergonomic work techniques • encourage person to avoid rushing while handling items	✓		low	low	low
4. Head/neck bent or twisted	• Inadequate head room causes awkward postures	82. Provide adequate work space • store item in area where there is adequate headroom	✓		low	med	med
		• use flow-racks to cue items to the front of a storage rack		✓	high	med	high
		55. Provide a hook-type tool to pull products off of deep shelves		✓	med	med	med

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Gripping item results in awkward wrist positions	94. Provide appropriate handles • provide cut-outs on boxes or containers		✓	med	low	med
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Rarely occurs	N/A					
8. Hand/grip forces	• Item is difficult to grasp • Item has no handles • Item is slippery	94. Provide appropriate handles		✓	med	med	med
		147. Provide an alternate container • provide a smaller container		✓	low to med	med	med
		• request vendor supply items in a container with handles		✓	med	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Item is too heavy	4. Change a lifting/carrying task into a rolling or sliding task • use a height adjustable cart to retrieve and deliver objects – the operator can slide objects rather than lift	✓	✓	low to med	med	med
		61. Provide a mechanical lift device		✓	med	low	med
		142. Use two or more people to perform the transfer	✓		low	low	low
		131. Reduce weight of work piece • request vendor ship unit on smaller bulk items or divide unit into multiple packages	✓	✓	low to high	low	low
	• Item is stuck or wedged in place	93. Provide appropriate gloves • use gloves with a high friction surface to improve the grip on slippery objects	✓		low to med	med	low
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Tearing open boxes	148. Provide appropriate equipment • use a knife for opening boxes	✓		low	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
10. Exposure to hard edges	• Item has small handles • Handles have hard edges	88. Provide an appropriate handle diameter • provide a wrap around the handle so that the diameter is no less than 1-1.5" (2.5-3.8cm)	✓		low	med	med
		94. Provide appropriate handles • provide rounded slightly compressible handles		✓	low to med	low	low
		61. Provide a mechanical lift device		✓	med to high	med	med
11. Hands and fingers exposed to cold temperatures	• Work area is too cold, for instance picking up stock in a freezer	12. Encourage appropriate seasonal clothing	✓		low to med	med	med
		93. Provide appropriate gloves	✓		low to med	med	med

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Object is too low	124. Raise the work piece/work surface					
		• place heaviest items between mid thigh and shoulder height	✓		low	med	med
		• provide a fixed table to support work piece		✓	med	med	med
		• provide an adjustable table or scissor lift for work piece		✓	med to high	med to high	med to high
		• raise the height of the transfer cart or use a spring loaded cart		✓	med	med	med
		13. Encourage ergonomic work techniques					
		• avoid storing items on lowest cart shelves	✓		low	med	med

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Object is too far away	38. Move closer to the work location					
		• step closer to load	✓		low	med	low
		41. Move work piece closer to person					
		• slide load to edge before lifting	✓		low	med	low
		37. Modify facility to decrease handling					
		• use flow-racks to cue items to the front of a storage rack		✓	med to high	low	med
		• install an automated retrieval storage system (AR/RS) or mechanized (carousel) picking/stocking system		✓	high	med	high
	• Lifting item out of a deep container causes awkward bending	147. Provide an alternate container					
		• provide a smaller container	✓		low	med	med
		• use a container with drop down sides		✓	med to high	med	med
		• use a pallet instead of a bin		✓	med to high	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Person tends to use the back to lift instead of using the legs to assist in the lift. Check to make sure that there is no contributing factor in the workplace	24. Raise the work piece/work surface					
		• place heaviest items between mid thigh and shoulder height	✓		low	med	med
		• provide a fixed table to support work piece		✓	med	med	med
		• provide an adjustable table or scissors lift for work piece		✓	med to high	med to high	med to high
		• raise the height of the transfer cart or use a spring loaded cart		✓	med	med	med
		13. Encourage ergonomic work techniques					
		• provide training on ergonomics principles and lifting techniques	✓		low	low	low
		• encourage person to use leg muscles to lift	✓		low	low	low
13. Twisting of the lower back	• Work area layout • Person tends to twist with the back instead of using the legs and feet to pivot	30. Reduce the angle a person has to turn to transfer the item					
		• if the transfer involves a 180 degree twist, move the source or destination to reduce the twist to 90 degrees or less	✓		low to high	low	med
		• reposition supplies/materials to reduce twisting	✓		low to med	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
14. High speed, sudden movements or Lifting awkward, uneven, shifting or bulky items.	• Item is bulky, awkward and/or shifts easily	61. Provide a mechanical lift device • store bulky and awkward items on pallets and use a fork truck to move them		✓	med	low	low
		42. Use two or more persons to perform the transfer	✓		low	low	low
		4. Change a lifting/carrying task into a rolling or sliding task • use a height adjustable cart to retrieve and deliver objects – the operator can slide objects from the shelves on to and off the cart		✓	low to med	med	med
	• Person tends to lift with a jerky motion instead of a smooth motion	47. Provide an alternate container • contact vendor and request re-packing object in container with handles or increasing object density		✓	med	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
15. Static, awkward back postures	• Object located too low 	124. Raise the work piece/work surface					
		• place heaviest items between knuckle and shoulder height (25"-50") (64-127 cm)	✓		low	low	med
		• provide a fixed table to support work piece	✓		low	med	med
		• provide an adjustable table or scissor lift for work piece		✓	high	med	med
		38. Move closer to the work location					
		• remove obstructions	✓		low	low	med
		41. Move the work piece closer to person	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	Level of Changes: ✓ Major Change	Cost	Impact On: Quality	Impact On: Productivity
	• Picking/stocking from a low location	24. Raise the work piece/work surface • place the heaviest items between knuckle and shoulder height and on middle shelves of storage racks	✓		low	med	med
		• provide an adjustable table		✓	med to high	med	med
		• raise the height of the transfer cart or use a spring loaded cart		✓	med	med	med
16. Lifting forces	• Item is too heavy	4. Change a lifting/carrying task into a rolling or sliding task		✓	high	med	med
		• use a height adjustable cart to retrieve and deliver objects – the operator can slide objects from the shelves on to and off the cart	✓		low	low	low
		61. Provide a mechanical lift device		✓	med	low	low
		42. Use two or more persons to perform the transfer	✓		low	low	low
		31. Reduce weight of work piece • request vendor ship unit on smaller bulk items or divide unit into multiple packages	✓	✓	low to high	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
		37. Modify facilities to decrease handling • install an automated retrieval storage system (AR/RS) or mechanized (carousel) picking/stocking system		✓	high	med	high
17. Pushing or pulling	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition • repair wheels on carts or equipment	✓		low	low	med
		19. Provide wheels • provide wheels with appropriate bearings and tread composition	✓		low	low	med
		67. Provide a powered cart • provide motorized assistance to transport cart or piece of equipment		✓	med to high	med	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition • improve housekeeping • repair cracks or gaps in floor • provide ramps to compensate for minor differences in floor height	✓ ✓	 ✓	low med med	med med med	med med med
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Standing in one position	25. Increase task variety	✓		low	low	low
		20. Incorporate rest pauses	✓		low	low	med
20. Standing on hard surfaces or exposure to hard edges on legs, knees, and feet	• Standing on hard surface • Leaning against bin during loading	86. Provide an appropriate anti-fatigue mat		✓	med	low	low
		96. Provide shoe inserts	✓		low to med	low	low
		47. Provide an alternate container • use smaller container	✓		low to med	low	med
		• use a container with drop down sides		✓	med to high	low	med
		• use a pallet instead of a bin		✓	low	low	low
21. Awkward leg postures	• Work object is too low	24. Raise the work piece/work surface • provide support for the work piece	✓		low to med	med	med
		• provide an adjustable table for work piece		✓	med to high	med	med
		• store frequently accessed items between 25"-50" (64-127 cm)	✓		low	med	med

Legs/Feet (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Climbing/descending ladder stairs to access taller shelves (particularly when carrying a load)	148. Provide appropriate equipment					
		• use a standing fork truck for shelves instead of portable ladders		✓	high	med	med
		• use a ladder/lift cart combination allowing the person to climb and descend without holding the object		✓	med	med	med
		42. Use two or more persons to perform the transfer					
		• have a person stand on the floor and hand items to the person on the stairs	✓		low	low	low
22. Awkward foot postures	• Work object is too low	24. Raise the work piece/work surface					
		• provide support for the work piece		✓	low to med	med	med
		• provide an adjustable table for work piece		✓	med to high	med	med
		48. Provide appropriate equipment					
		• use a ladder with at least 12" (30.5cm) deep steps in place of the small rungs		✓	med	low to med	low to med

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Low light level due to location of the component	18. Improve visual access to work • provide a portable task light that can be moved around the area or clamped onto a support work surface to improve light levels (75fc to 100fc)	✓		low to med	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A		✓	med	med	med

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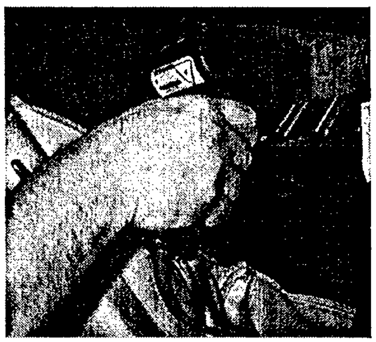
CASE STUDY - Scanning/Bar Code Reading (Hand Held)	
TASK TITLE: Scanning/Bar Code Reading (Hand Held)	
Task Description:	The Scanning/Bar Code Reading (Hand Held) task typically occurs in warehouses in order to track incoming or outgoing items. The employee uses a hand held scanner to read bar codes that may be attached to a container or on the paperwork. The employee may scan directly on boxes or scan paperwork while sitting at a work desk. Typical areas in which the Scanning/Bar Code Reading (Hand Held) task may be found can include: • Receiving Operations • Picking
Job Performance Measures Most Often Impacted by Scanning/Bar Code Reading (Hand Held):	Measure of work performance can include (but are not necessarily limited to): • Items processed per day
Typical Employee Comments about Scanning/Bar Code Reading (Hand Held):	Employees rarely attribute discomfort to the scanning task. The hands/wrists/arms is the body area that most commonly receives a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive "Medium" priority rating, or lower.
Suggested Level II Analysis:	Postural Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Object is too high	32. Lower the work piece / work surface • reduce the conveyor height		✓	med to high	low	med
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Positioning of items	41. Move work piece closer to body • position the bar codes on the side of the box instead of the top	✓		low	med	high
3. High speed, sudden shoulder movements	• Rarely occurs	N/A					
4. Head/neck bent or twisted	• Inspecting inside boxes	32. Lower the work piece / work surface • use an adjustable height table or conveyor section		✓	med to high	med	med

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Scanning from labels placed flat on the desk surface	146. Angle the work surface • Use a document holder or angled stand to support the labels during scanning	✓		med to low	low	med
		148. Provide appropriate equipment • install a surface mounted scanner in the desk, similar to those used by cashiers		✓	low	med	med
	• Scanning from awkward locations on boxes	149. Provide appropriate tools • select scanner gun models which can read from longer distances and off-center angles		✓	med to high	med	high
		41. Move work piece closer to body • rotate boxes to place labels closer to the employee	✓		low	low	med
		• consider the label location when placing boxes on conveyors or tables	✓		low	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Scanner has single finger operation	149. Provide appropriate tools • select a model with at least two finger activation		✓	med	med	med
	• Scanner requires repeated inputs on small keys	11. Eliminate unnecessary tasks • transfer frequently keyed information into barcodes placed in a book		✓	med	med	high
8. Hand/grip forces	• Rarely occurs	N/A					
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Rarely occurs	N/A					
10. Exposure to hard edges	• Rarely occurs	N/A					
11. Hands and fingers exposed to cold temperatures	• Rarely occurs	N/A					

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Object is too low	124. Raise the work piece/work surface					
		• raise the conveyor		✓	med to high	low	med
		• provide a fixed table to support work piece		✓	low to med	low	med
	• Scanning location is too low	41. Move work piece closer to body					
		• rotate boxes to place labels closer to the employee	✓		low	low	med
		• consider the label location when placing boxes on conveyors or tables	✓		low	med	med
		149. Provide appropriate tools					
		• select scanner gun models which can read from longer distances and off-center angles		✓	med to high	med	high
13. Twisting of the lower back	• Scanning is performed in a restricted space	149. Provide appropriate tools					
		• select scanner gun models which can read from longer distances and off-center angles		✓	med to high	med	high
		41. Move work piece closer to body					
		• rotate boxes to place labels closer to the employee	✓		low	low	med
		• consider the label location when placing boxes on conveyors or belts	✓		low	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
14. High speed, sudden movements or Lifting awkward, uneven, shifting or bulky items.	• Rarely occurs	N/A					
15. Static, awkward back postures	• Rarely occurs	N/A					
16. Lifting forces	• Rarely occurs	N/A					
17. Pushing or pulling	• Rarely occurs	N/A					
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Rarely occurs	N/A					
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Standing on a hard surface	86. Provide an appropriate anti-fatigue mat 96. Provide appropriate shoe inserts 143. Wear appropriate shoes	 ✓	✓ ✓ 	med to high low low	low low low	low low low
21. Awkward leg postures	• Work object is too low	124. Raise the work piece / work surface • provide support for the work piece • provide an adjustable table for work piece		✓ ✓	med to high low to med	low low	low med
22. Awkward foot postures	• Rarely occurs	N/A					

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	18. Improve visual access to work • Light level should be 50fc to 75fc for the work		✓	low to med	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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CASE STUDY – Scanning (Groceries) / Tendering Money	
TASK TITLE: Scanning (Groceries) / Tendering Money	
Task Description:	The Scanning (Groceries) / Tendering Money task may be involved when working in a deli, convenience store or commissary. The tasks involve entering information using a keypad or scanner, handling money and individual items. Typical jobs in which Scanning (Groceries) / Tendering Money tasks are performed include (but are not necessarily limited to): • Commissary • Convenience store • Restaurant
Job Performance Measures Most Often Impacted by Scanning (Groceries) / Tendering Money:	• Scanning accuracy • Money collection accuracy
Typical Employee Comments about Scanning (Groceries) / Tendering Money:	Employees typically experience discomfort in the shoulder/neck and hands/wrists/arms, which can be attributed to moving items across scanner. The shoulder/arms and hands/wrists/arms are the body areas that most commonly receive a "High" priority rating. The remaining areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	Elemental Task Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Object is too high	32. Lower the work piece / work surface • place the keypad on a height and angle adjustable pedestal so that the keypad is shoulder height or lower but does not interfere with the flow of groceries		✓	low to high	med	med
		123. Raise the person • provide a platform or stand	✓		low	low	low
	• Object is too far away 	13. Encourage ergonomic work techniques • instruct individuals to use the conveyor belt to bring groceries as close to the body as possible prior to lifting and handling the grocery item	✓		low	low	low
		41. Move work piece closer to body • use a divertor guide to bring groceries close to cashier. The divertor pushes groceries towards the cashier side of the counter as the conveyor moves forward.		✓	low to med	low	Med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
2. Arm forces: Repeated arm forces or holding / carrying materials	• Raised lip on front of scanner prevents products from sliding	35. Maintain tracks, rollers and movement mechanisms					
		• adjust conveyor belt and scanner to ensure a smooth transition.	✓		low	high	high
		• clean and maintain scanner on a regular basis	✓		low	high	high
	• Person lifts item for scanning	148. Provide appropriate equipment					
		• provide a scanner which can scan bar codes in different orientations		✓	high	high	high
		13. Encourage ergonomic work techniques					
		• encourage person to slide items rather than lifting them, (assumes high quality scanner)	✓		low	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements	• Speed of lift	13. Encourage ergonomic work techniques					
		• encourage person to use smooth fluid movements while handling items.	✓		low	low	low
		• encourage person to use smooth fluid movements to move grocery items across scanner	✓		low	low	low
		41. Move work piece closer to body					
		• use a divertor guide to bring groceries close to cashier. The divertor pushes groceries towards the cashier side of the counter as the conveyor moves forward, thus sudden shoulder movements are not required to bring the item to the cashier.		✓	low to med	low	Med

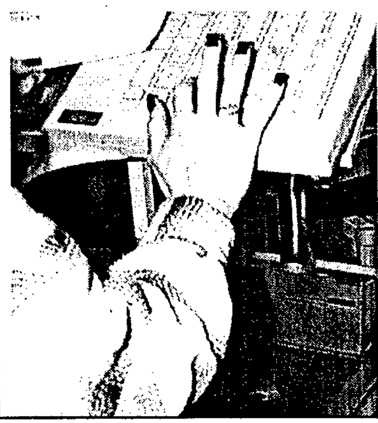
Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
4. Head/neck bent or twisted	• Work piece position too low and off to one side	13. Encourage ergonomic work techniques • encourage person to use conveyor belt to move item directly in front of the body and minimize turning the head to view items positioned away from the scanning area	✓		low	low	low
		124. Raise the work piece / work surface • position keypad on a height adjustable pedestal to raise the keypad to a position that does not require severe bending of the neck		✓	high	med	med
		150.Re-design work space • position keypad directly in behind and over the conveyor belt so that person can face the groceries on the conveyor rather than looking down and to the right		✓	low to high	med	med

Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes ✓ Minor Modification	✓ Major Change	Cost	Impact On: Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Shape of item causes awkward wrist positions 	13. Encourage ergonomic work techniques					
		• encourage individual to allow the conveyor to bring the object to the scanner or weight scale	✓		low	low	low
		• use to hands to lift heavy awkward items	✓		low	low	low
		149. Provide appropriate tools					
		• investigate the use of a hand held scanner or scanner than can be adjusted to allow the individual to avoid handling the item		✓	med to high	med	med
		20. Incorporate rest pauses	✓		low	low	low
	• Height and angle of keypad causes awkward wrist positions	152. Relocate the work					
		• position keypad on a height and angle adjustable pedestal to improve wrist posture.		✓	low to med	med	med
	• Raised lip on front of scanner prevents products from sliding	35. Maintain tracks, rollers, and movement mechanisms					
		• adjust conveyor belt and scanner to ensure a smooth transition.	✓		low	high	high
		• clean and maintain scanner on a regular basis	✓		low	high	high

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	Level of Changes: ✓ Major Change	Cost	Impact On: Quality	Impact On: Productivity
	• Person lifts item for scanning	148. Provide appropriate equipment • provide a scanner which can scan bar codes in different orientations		✓	med to high	high	high
		13. Encourage ergonomic work techniques • encourage person to slide items rather than lifting them (assumes high quality scanner)	✓		low	med	med
6. Repeated manipulations with fingers	• Keying information into the keypad causes repeated finger manipulations 	13. Encourage ergonomic work techniques • encourage individual to use scanner whenever possible to enter product information	✓		low	low	low
		11. Eliminate unnecessary tasks		✓	high	med	high

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
7. Hyper-extension of finger/thumb or repeated single finger activation	• Item is difficult to grasp 	13. Encourage ergonomic work techniques					
		• push instead of grab and lift	✓		low	med	med
		• use two hands to lift heavy or awkward items	✓		low	low	low
		11. Eliminate unnecessary tasks					
		• implement an advanced checkout system that has clients scan and process their own items		✓	high	high	high
8. Hand/grip forces	• Item is difficult to grasp • Item has no handles	13. Encourage ergonomic work techniques					
		• encourage the use of the conveyor to transport items as close to the individual as possible	✓		low	low	low
		• use two hands to lift heavy or awkward items	✓		low	low	low
		• leave heavy items in the grocery cart	✓		low	low	low
	• Raised lip on front of scanner prevents products from sliding	35. Maintain tracks, rollers, and movement mechanisms					
		• adjust conveyor belt and scanner to ensure a smooth transition.	✓		low	high	high
		• clean and maintain scanner on a regular basis	✓		low	high	high

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Person lifts item for scanning	148.Provide appropriate equipment • provide a scanner which can scan bar codes in different orientations		✓	high	high	high
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Scanning groceries	13. Encourage ergonomic work techniques • encourage person to slide items rather than lifting them, (assumes high quality scanner)	✓		low	med	med
		11. Eliminate unnecessary tasks • implement an advanced checkout system that has clients scan and process their own items		✓	high	high	high
10. Exposure to hard edges	• Rarely occurs	N/A					
11. Hands and fingers exposed to cold temperatures	• Rarely occurs - handling of frozen goods is too low to be considered an exposure	N/A					

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes ✓ Minor Modification	✓ Major Change	Cost	Impact On Quality	Productivity
12. Repeated forward or sideways bending movements	• Object is too low 	124. Raise the work piece/work surface • raise conveyor		✓	high	med	med
	• Object is too far away	38. Move closer to the work location • remove obstructions • walk around the counter to handle items located in grocery carts	✓ ✓		low low	low low	low low
		41. Move work piece closer to body • use a divertor guide to bring groceries close to cashier, thus pushing groceries towards the cashier side of the counter as the conveyor moves forward.		✓	low to med	low	med
	• Lifting item out of a deep container causes awkward bending	47. Provide an alternate container • provide shallower grocery carts with detachable edges so that items can be slid out of the cart rather than lifted out of the cart		✓	high	med	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Person tends to use the back to lift instead of using the legs to assist in the lift (Check to make sure that there is no contributing factor in the workplace)	11. Eliminate unnecessary tasks • place tags on heavy items or replace shelving of item with sample and tags. Scan the tag instead of the item.		✓	med to high	low	med
		13. Encourage ergonomic work techniques • provide training on ergonomics principles and techniques	✓		low	low	low
		• encourage person to use leg muscles to lift	✓		low	low	low
13. Twisting of the lower back	• Access is restricted to items that need to be handled • Person tends to twist with the back instead of using the legs and feet to pivot	41. Move work piece closer to body • use a divertor guide to bring groceries close to cashier. The divertor pushes groceries towards the cashier side of the counter as the conveyor moves forward.		✓	low to med	low	med
		13. Encourage ergonomic work techniques • encourage person to use conveyor to bring item to them	✓		low	low	low
		• provide training on ergonomics principles	✓		low	low	low
		• encourage person to use legs to pivot when handling a load	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
14. High speed, sudden movements, or lifting awkward, uneven, shifting or bulky items	• Person tends to lift with a jerky motion instead of a smooth motion	13. Encourage ergonomic work techniques • encourage person to use smooth fluid movements while handling items	✓		low	low	low
		11. Eliminate unnecessary tasks • place tags on heavy items or replace shelving of item with sample and tags. Scan the tag instead of the item.		✓	high	med	med
15. Static, awkward back postures	• Work positioned too low	124. Raise the work piece / work surface • raise cash counter or grocery counter so that the items are located just below elbow height		✓	high	med	med
	• Items positioned too far from the body	13. Encourage ergonomic work technique • encourage individual to allow the item to move closer using the conveyor	✓		low	low	low
		50. Re-design the work space • use a divertor to move products closer to the cashier		✓	med	low	med

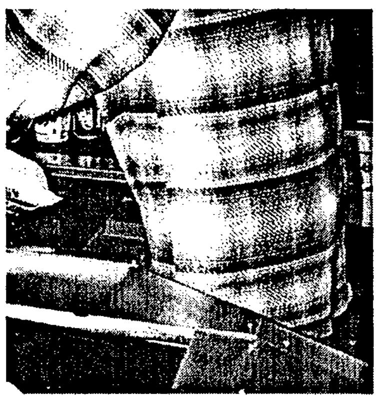
Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
16. Lifting forces	• Item is too heavy • Person lifts items for scanning	41. Move work piece closer to body					
		• instruct person to use the conveyor belt to bring groceries as close to the body as possible prior to lifting and handling the grocery item	✓		low	low	low
		11. Eliminate unnecessary tasks					
		• instruct person to encourage customer to leave heavy items in the grocery cart rather than lifting the item from the cart	✓		low	low	low
		• place tags on heavy items or replace shelving of item with sample and tags. Scan the tag instead of the item.		✓	high	med	med
		149. Provide appropriate tools					
		• provide a hand scanner so that heavy items can be left in the cart		✓	low to high	low	low
	• Raised lip on front of scanner prevents products from sliding	35. Maintain tracks, rollers, and movement mechanisms					
		• adjust conveyor belt and scanner to ensure a smooth transition.	✓		low	high	high
		• clean and maintain scanner on a regular basis	✓		low	high	high

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Person lifts item for scanning	148. Provide appropriate equipment • provide a scanner which can scan bar codes in different orientations		✓	high	high	high
		13. Encourage ergonomic work techniques • encourage person to slide items rather than lifting them (assumes high quality scanner)	✓		low	med	med
17. Pushing or pulling	• Rarely occurs	N/A					
18. Whole body vibration	• Rarely occurs	N/A					
19. Fixed position, standing	• Stands in one position	52. Provide a footrail or footrest • provide a footrest/footrail that allows the person to periodically raise one leg		✓	med	low	low

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
20. Standing on hard surfaces or exposure to hard edges on legs, knees, and feet	• Stands on a hard surface	86. Provide an appropriate anti-fatigue mat • anti-fatigue matting should be large enough to accommodate movement of the person		✓	med	med	med
		96. Provide appropriate shoe inserts	✓		low to med	med	med
	• Leans against conveyor frame 	9. Eliminate exposure to hard edges • provide high density foam padding		✓	med	low	low
		13. Encourage ergonomic work techniques • encourage individual to allow the item to move closer using the conveyor	✓		low	low	low
		50. Re-design the work space • use a divertor to move products closer to the cashier		✓	med	low	med

Legs/Feet (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
21. Awkward leg postures	• Rarely occurs	N/A					
22. Awkward foot postures	• Lack of toe clearance	80. Provide adequate leg clearance		✓	med to high	low	med
		81. Provide adequate toe clearance		✓	med to high	low	med
		132. Remove obstructions • clear boxes, items from floor to allow room	✓				

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Glare on monitor/screen	18. Improve visual access to work • position key pad read out to minimize glare	✓		low to med	high	med
		02. Provide displays which are readable and easy to understand		✓	med to high	med	med
		09. Provide protection from glare from overhead lights/tasks lights	✓		low	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	20. Incorporate rest pauses	✓		low	high	med

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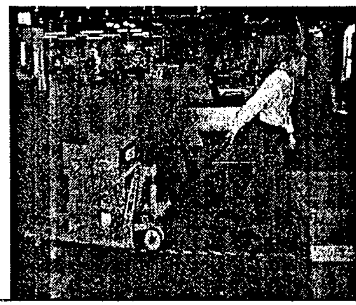
CASE STUDY - Transporting Loads on Non-Powered Carts

TASK TITLE: Transporting Loads on Non-Powered Carts	
Task Description:	The Transporting Loads on Non-Powered Carts task involves the use of non-powered carts to move loads (palletized or loose) from one location to another. While the most common cart in a warehouse setting is the pallet jack, other devices considered include: hand truck, shelf style truck (e.g., bottom, center, and top shelves with a handle at one end), and flatbed style (e.g., single surface low to the ground with a handle at one end). Carts may be equipped with swivel wheels that may or may not lock into position. Carts may be used in open areas or to navigate narrow aisles. The carts are typically pushed as well as pulled. [Since the work situation can also include loading and unloading carts, please refer to Case Study 11 – Loading/Unloading for further guidance.] Typical environments in which transporting loads on non-powered carts occurs (but are not necessarily limited to): • pallet transport/transfer • short distance stock delivery (e.g., from storage to point of use)
Job Performance Measures Most Often Impacted by Transporting Loads on Non-Powered Carts	Measure of work performance can include (but are not necessarily limited to): • the number of loads handled per day. (Note: It is also important that the carts are handled in such a way as to avoid damage to the materials being transported or accidents involving other personnel and the surrounding area and equipment.)
Typical Employee Comments about Transporting loads on Non-Powered Carts	Employees typically experience discomfort in the back/torso, shoulders and sometimes legs/feet. The back/torso is the body area that most commonly receives a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating, or lower.
Suggested Level II Analysis:	Dynamic task Analysis, Biomechanical Lifting Analysis, NIOSH Lifting Equation, Push/Pull Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Handles are too high • Handle is too close to the cart; inadequate clearance for the legs when walking 	94. Provide appropriate handles • modify current handles or add a handle; handle height should be between 36-44"(91-112cm) above the floor, fixed handles should be extended at lease 8"(20cm) from the cart.	✓		low	low	low
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Repeated pumping of pallet jack to raise pallet off the floor for transport	61. Provide a mechanical lift device • provide a powered scissors jack • use a fork lift to transport load	✓	✓	high low	low low	med med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Manual pushing/pulling loads 	67. Provide a powered cart • contact vendor to consider providing powered vehicles		✓	med to high	low	med
3. High speed, sudden shoulder movements	• Emergency stopping of carts can create excessive force on the shoulders	148. Provide appropriate equipment • contact supplier to investigate equipping pallet jack or other carts with a hand brake		✓	med	low	low
4. Head/neck bent or twisted	• Viewing around loads	148. Provide appropriate equipment • investigate the use of convex mirrors mounted on ceiling to see work area (particularly at intersections)	✓		low to med	low	med
		147. Provide an alternative container • reduce high/size of load		✓	low to med	low	med

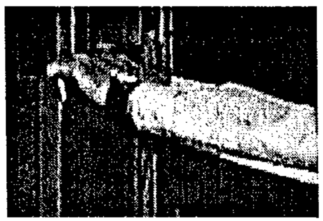
Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Repeated pumping of pallet jack to raise pallet off the floor for transport	61. Provide a mechanical lift device					
		• provide a powered scissors jack		✓	high	low	med
		• use a fork lift to transport load	✓		low	low	med
	• Handle on cart too low	94. Provide appropriate handles					
		• replace horizontal handle with two vertical handles, shoulder width apart	✓		low	low	low
		• reposition horizontal handle at between 36-44 inches (91-112cm) above the floor	✓		low	low	low
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Rarely occurs	N/A					

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes: ✓ Minor Modification	✓ Major Change	Cost	Impact On: Quality	Productivity
8. Hand/grip forces	• Repeated pumping of pallet jack to raise pallet off the floor for transport	61. Provide a mechanical lift device					
		• provide a portable pneumatic scissors jack		✓	high	low	med
		• use a fork lift to transport load	✓		low	low	med
	• Pushing/pulling loads	67. Provide a powered cart • use a powered cart if forces exceed guidance		✓	med to high	low	med
	• Inappropriate wheel material (e.g., steel/too hard for floor type) or poor wheel maintenance (e.g., stuck or shaking wheels)	19. Improve wheel condition • replace worn wheels when necessary; carts with damaged wheels can jam suddenly		✓	med	low	med
		119. Provide wheels • provide wheels which roll easily on floor surface		✓	med	low	med
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Repeated pushing of carts over rough or damaged floor surfaces	17. Improve floor condition					
		• improve housekeeping	✓		low	low	low
		• repair cracks or gaps in floor		✓	med	low	med
	• Inappropriate wheel material (e.g., steel/too hard for floor type) or poor wheel maintenance (e.g., stuck or shaking wheels)	119. Provide wheels • replace worn wheels when necessary; carts with flattened wheels are harder to push than those whose wheels are rounded		✓	med	low	med
		• replace steel wheels with softer material (when appropriate for the work environment)		✓	med	low	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
10. Exposure to hard edges	• Handle shape creates a pressure point in the hand 	9. Eliminate exposure to hard edges • wrap square tubular handles with padding to cushion the hand • replace blunt edge handles with a rounded design	 ✓ ✓		 low low	 low low	 low low
11. Hands and fingers exposed to cold temperatures	• Work area is too cold	23. Increase room temperature • encourage employees to keep doors shut 93. Provide appropriate gloves 12. Encourage appropriate seasonal clothing	 ✓ ✓ ✓		 low low low	 low low low	 low low low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
12. Repeated forward or sideways bending movements	• Placing loose stock or other items on lower shelves on cart or on flat bed cart	124. Raise the work piece/work surface • avoid use of the bottom shelf on carts whenever possible; load carts to maintain load stability	✓		low	low	low
	• Handle on cart is too low 	94. Provide appropriate handles • replace horizontal handle with two vertical handles, shoulder width apart	✓		low	low	low
		• reposition horizontal handle at between 36-44"(91-112cm) above the floor	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
13. Twisting of the lower back	• Carts drift or are difficult to control, especially when turning corners	119. Provide wheels • place swivel wheels on only the "handle side" of the cart for optimum control (push carts)		✓	med	low	low
		• if all wheels swivel, "lock" the wheel position into "straight" on the side opposite the handle	✓		low	low	low
		13. Encourage ergonomic work techniques • do not overload trucks; the height of the load should be no higher than 55"(140cm) if the load is to be pushed	✓		low	low	low
	• Maneuvering through narrow aisles or around obstructions	82. Provide adequate work space • increase the width of the aisles to at least 11 feet (assuming a one-way flow) and maintain appropriate width by painting guidelines or pallet position spaces on the floor		✓	high	low	low
	• Person tends to twist with the back instead of using the legs and feet to pivot	13. Encourage ergonomic work techniques • provide training on ergonomics principles and materials handling techniques	✓		low	low	low
		• encourage person to use legs and pivot while transferring loads or loading/unloading carts	✓		low	low	low

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
14. High speed, sudden movements or Lifting awkward, uneven, shifting or bulky items.	• Emergency stopping of carts can create excessive force on the shoulders	148. Provide appropriate equipment • contact supplier to investigate equipping pallet jack or other carts with a hand brake		✓	med	low	low
15. Static, awkward back postures	• Handle on cart is too low	94. Provide appropriate handles • replace horizontal handle with two vertical handles, shoulder width apart • reposition horizontal handle at between 36-44"(91-112cm) above the floor	✓ ✓		low low	low low	low low
16. Lifting forces	• Item(s) being lifted onto/off cart is too heavy	61. Provide a mechanical lift device • use a hoist to perform the lift • use a portable pneumatic scissors jack; position the height of the jack so the operator can slide rather than lift the item		✓ ✓	high high	low low	med med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	• Rolling or sliding resistance of cart causes high forces	119. Provide wheels • provide wheels with appropriate bearings and tread composition		✓	med	low	med
	• Worn wheels increase forces	19. Improve wheel condition • replace worn wheels		✓	med	low	med
	• Cart/load is too heavy to be moved manually (maximum forces: start - 50 pounds force, maintain travel - 25 pounds force, emergency stop (within 3 feet) - 80 pounds force)	151. Reduce weight of load on cart	✓		low	low	low
		67. Provide a powered cart • provide a motorized cart		✓	high	low	med
	• Poor floor surface/condition	17. Improve floor condition • improve housekeeping • repair cracks or gaps in floor	✓ ✓		low med	low low	low med
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Rarely occurs	N/A					
20. Standing on hard surfaces or exposure to hard edges on legs, knees, and feet	• Continuous walking while transporting loads can increase the potential for fatigue in the legs and feet	20. Incorporate rest pauses	✓		low	low	low
		96. Provide appropriate shoe inserts		✓	low	low	low
21. Awkward leg postures	• Rarely occurs	N/A					
22. Awkward foot postures	• Rarely occurs	N/A					

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	18. Increase visual access to work • Light level should be 10fc to 20fc for the work		✓	low to high	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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CASE STUDY - Lifting

TASK TITLE: Lifting

Task Description:	Lifting involves the manual handling of items of varying weights and sizes. It involves the transfer of items at between varying heights and locations (floor/shelves or a work surface). Pushing and pulling typically occur while moving carts or pieces of equipment. Pushing and pulling can also occur while removing and installing components. • Lifting/pushing/pulling are components of many jobs.
Job Performance Measures Most Often Impacted by Lifting:	Measures of performance can include (but are not necessarily limited to): • Speed of completion of the larger task. • Component damage during handling.
Typical Employee Comments about Lifting:	Employees typically complain about discomfort in the back/torso, legs/feet, hands/wrists, arms, and shoulders/neck. The back/torso is the body area that most commonly receives a "High" priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive a "Medium" priority rating or lower.
Suggested Level II Analysis:	NIOSH Lifting Equation, Biomechanical Lifting Analysis, Push/Pull Force Analysis

Shoulder/Neck

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	• Object is too high	32. Lower the work piece/work surface					
		• place heaviest items between shoulder height and knuckle height (25"-50") (64-127 cm)	✓		low	med	med
		• place heaviest items on middle shelves of storage racks	✓		low	med	med
	• Object is too far away	38. Move closer to the work location	✓	✓	med	med	med
		41. Move work piece closer to body • slide load to edge before lifting	✓		low	med	med
2. Arm forces: Repeated arm forces or holding/ carrying materials	• Item is too heavy	61. Provide a mechanical lift device		✓	high	low	med
		131. Reduce weight of work piece		✓	med	med	med
		142. Use two or more persons to perform the transfer	✓		low	low	low
		26. Increase weight of work piece • ensures that the item will be handled mechanically		✓	med	med	med
		4. Change a lifting/carrying task into a rolling or sliding task • use a portable lift cart to retrieve and deliver objects		✓	low to med	med	med

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• High forces required to install or remove component	128. Reduce force required to install or remove the component					
		• use lubricant where feasible	✓		low	med	med
		• modify design of component or subsystem to reduce forces during installation or removal		✓	high	med	med
	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition					
		• repair wheels on carts or equipment	✓		med	med	med
		• install appropriate wheels		✓	low to med	med	med
	• Cart or piece of equipment is too heavy to be pushed manually	131. Reduce weight of work piece					
		• reduce number of items or weight of items on cart	✓		low	low	med
		67. Provide a powered cart		✓	med to high	low	med
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition					
		• improve housekeeping	✓		low	low	med
		• repair cracks or gaps in floor	✓		med	low	med
		• provide ramps to compensate for minor differences in floor height		✓	med to high	low	med
	• Item is stuck or wedged in place	132. Remove obstacles					
		• take time to remove obstacles interfering with movement rather than trying to "force" the object free	✓		low	low	low

Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Carry distance is more than three steps	126. Reduce carry distance					
		• arrange storage and work areas to reduce travel distances	✓		low	low	med
		48. Provide a cart					
		• to transport materials		✓	med	low	med
		11. Eliminate unnecessary tasks					
		• eliminate or combine handling tasks	✓		low	low	med
		• transport items in larger quantities instead of handling them individually	✓		low	low	med
		37. Modify facilities to decrease handling					
		• widen doors to allow materials to be handled on carts		✓	high	low	med

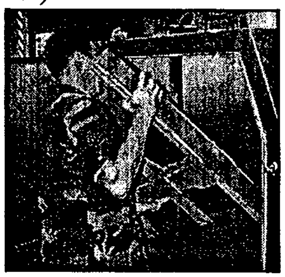
Shoulder/Neck (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements	• Speed of lift	13. Encourage ergonomic work techniques					
		• encourage person to avoid rushing while handling items	✓		low	low	med
	• Item is stuck in location • Item is difficult to install	128. Reduce force required to install or remove the component					
		• use lubricant where feasible	✓		low	med	med
		• modify design of component or subsystem to reduce forces during installation or removal		✓	high	med	med
4. Head/neck bent or twisted	• Inadequate head room causes awkward postures	82. Provide adequate workspace					
		• store item in area where there is adequate headroom	✓		low	low	med
		• use flow-racks to cue items to the front of a storage rack		✓	high	low	high
		55. Provide a hook-type tool to pull items		✓	low	low	med

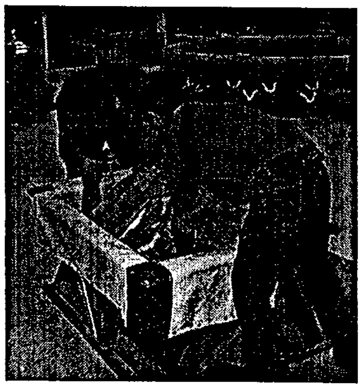
Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	• Shape of grasping location (handle) on work piece causes awkward wrist positions	94. Provide appropriate handles					
		• provide handles which pivot slightly to permit a straight wrist during handling		✓	med	low	med
		• provide cut-outs on boxes or containers		✓	med	low	med
6. Repeated manipulations with fingers	• Rarely occurs	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	• Handling large products	148. Provide an alternate container					
		• provide a smaller container	✓		med	med	med
		• provide a more stable container		✓	med	med	med
		94. Provide appropriate handles		✓	med	med	med
		61. Provide a mechanical lift device		✓	med	med	med

Hands/Wrists/Arms (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
8. Hand/grip forces	• Item is difficult to grasp • Item has no handles • Item is slippery (see Figure 1.1) 	61. Provide a mechanical lift device 94. Provide appropriate handles 93. Provide appropriate gloves • use gloves with a high friction surface [redacted]	 ✓	✓ ✓ 	med to high med low	low med low	med med low
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	• Rarely occurs	N/A					
10. Exposure to hard edges	• Handles have hard edges • Item has small handles	94. Provide appropriate handles • provide compressible handles 61. Provide a mechanical lift device 88. Provide an appropriate handle diameter	 ✓	✓ ✓ 	low to med med low to med	low med low	low med low

Back/Torso

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
11. Hands and fingers exposed to cold temperatures	• Work area is too cold	105. Provide portable heaters		✓	med	med	med
		93. Provide appropriate gloves		✓	low	med	med
12. Repeated forward or sideways bending movements	• Object is too low (see Figure 1.2) 	124. Raise the work piece/work surface					
		• place heaviest items between knuckle and shoulder height (25"-50") (64-127 cm)	✓		low	low	low
		• provide a fixed table to support work piece		✓	low	med	med
		• provide an adjustable table for work piece		✓	high	med	high
		• place heaviest items on middle shelves of storage racks	✓		low	low	med
	• Object is too far away	38. Move closer to the work location	✓	✓	med	med	med
		132. Remove obstructions	✓		low	med	med
		41. Move work piece closer to the body	✓		low	med	med
		46. Provide a ball-bearing rotation table		✓	med to high	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Lifting item out of a deep container causes awkward bending	69. Provide a smaller container	✓	✓	med	low	med
	• Item is handled in a restricted space • Work area layout	82. Provide adequate work space		✓	low to med	low	med
		130.Reduce the angle a person turns to transfer an item • for example, if the transfer involves a 180 degree twist, move the source or destination to reduce the twist to 90 degrees or less	✓		low	low	med
	• Person tends to use the back to lift instead of using the legs to assist in the lift (check to make sure that there is no contributing factor in the workplace)	13. Encourage ergonomic work techniques • provide training on ergonomics principles and lifting techniques	✓		low	low	med
		• encourage person to use leg muscles to lift	✓		low	low	med
13. Twisting of the lower back	• Access is restricted to a component that needs to be removed	82. Provide adequate workspace • improve access during installation and removal	✓		low	low	high

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Item is handled in a restricted space	61. Provide mechanical lift device • provide mechanical assistance for handling the load		✓	med to high	low	med
	• Work area layout	130. Reduce the angle a person turns to transfer an item • for example, if the transfer involves a 180 degree twist, move the source or destination to reduce the twist to 90 degrees or less	✓		low	low	med
	• Person tends to twist with the back instead of using the legs and feet to pivot	13. Encourage ergonomic work techniques • provide training on ergonomics principles and lifting techniques • encourage person to use legs pivot when handling a load	✓ ✓		low low	low low	med med
14. High speed, sudden movements	• Item is stuck in location • Item is difficult to install or remove	128. Reduce force required to install or remove the component • use lubricant where feasible • modify design of component or subsystem to reduce forces during installation or removal	✓	✓	low high	low med	med high

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	• Item is bulky, awkward or shifts easily	61. Provide a mechanical lift device		✓	med	med	med
	• Person tends to lift with a jerky motion instead of a smooth motion	13. Encourage ergonomic work techniques • encourage person to avoid rushing while handling items	✓		low	low	med
15. Static, awkward back postures	• Rarely occurs	N/A					
16. Lifting forces	• Item is too heavy	61. Provide a mechanical lift device		✓	high	low	med
		131. Reduce weight of work piece	✓		low	low	med
		142. Use two or more persons to perform the transfer	✓		low	low	med
		26. Increase weight of work piece • ensures that the item will be handled mechanically		✓	high	low	med
	• High forces are required to install or remove the component	128. Reduce force required to install or remove the component • use lubricant where feasible	✓		low	low	med
		• modify design of component or subsystem to reduce forces during installation or removal		✓	high	low	med

Back/Torso (cont'd)

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	• Rolling/sliding resistance of cart or piece of equipment causes high forces	19. Improve wheel condition • repair wheels on carts or equipment	✓		low	low	med
	• Cart or piece of equipment is too heavy to be pushed manually	131. Reduce weight of work piece • reduce number of items or weight of items on cart	✓		low	low	med
		67. Provide a powered cart • provide motorized assistance to transport cart or piece of equipment		✓	high	low	high
	• Floor/surface condition causes high forces during a rolling or sliding task	17. Improve floor condition • improve housekeeping • repair cracks or gaps in floor • provide ramps to compensate for minor differences in floor height	✓ ✓	 ✓	low med high	low low low	med med med
18. Whole body vibration	• Rarely occurs	N/A					

Legs/Feet

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	• Rarely occurs						
20. Exposure to hard edges on legs, knees, and feet **or** Standing on hard surfaces	• Standing on hard surfaces	86. Provide an appropriate anti-fatigue mat 96. Provide appropriate shoe inserts	✓ ✓		low to med low	low low	low low
21. Awkward leg postures	• Work object is too low	124. Raise the work piece/ work surface 118. Provide support for the work piece • provide an adjustable table for work piece	✓	✓	med high	med med	med high
22. Standing foot pedal	• Rarely occurs	N/A					

Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see/light levels too low/too high	• Rarely occurs	18. Improve visual access to work • light levels should be 50 fc - 70 fc for work		✓	low to high	med	med
24. Intensive visual tasks, staring at work objects for long periods	• Rarely occurs	N/A					

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APPENDIX 5

Recommendations

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APPENDIX 5

This Appendix corresponds with *Step 5: Recommendations*. It includes the following sections:

- Using Design Criteria to Implement Major Purchases (Section A.5.1)
- Implementing Minor Modifications (Section A.5.2)
- A Sample Completed Level I Ergonomics Assessment Summary and Recommendations Form

The section entitled *Using Design Criteria to Implement Major Purchases* is to be used in situations where ergonomics criteria are required for selecting a new, potentially major piece of equipment such as a lift table, cart, or other item. The "Implementation Reference" column on the Corrective Action List refers directly to information provided in this section.

The focus of this section is on design and selection criteria for major purchases. Because a shop may not be able to implement these types of recommendations immediately, this section may only be needed in special situations. Each time an assessment is performed, however, it may be useful to inform the shop supervisor that the BEF can provide assistance in selecting equipment that is beneficial to employees and of value to the shop. This information may also be useful to the person or organization responsible for procurement.

The section entitled *Implementing Minor Modifications* includes guidance on how to actually make or implement the minor modifications (i.e., changes and adjustments to existing materials, handling tasks, etc.) that have already been identified using the case studies. The "Implementation Reference" column on the Corrective Action List refers directly to the information provided in this section. The information complements that found in the case studies and will be helpful each time the Level I process is applied.

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A.5.1 USING DESIGN CRITERIA TO IMPLEMENT MAJOR PURCHASES

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A.5.1 USING DESIGN CRITERIA TO IMPLEMENT MAJOR PURCHASES

Many of the corrective actions in the case studies refer to the tools and equipment that help reduce the risk of WMSDs and improve performance of the tasks. Criteria for the most commonly recommended equipment are included in this section. To make this Guide Supplement as complete as possible, the criteria for Overhead Lifting Devices and Hand Tools/Power Tools, which originally appeared in the M/I Guide, are also provided.

The design criteria included are as follows:

- Overhead Lifting Devices (e.g., Hoists, Cranes) (Section A.5.1.1)
- Hand Tools/Power Tools (Section A.5.1.2)
- Height-Adjustable Lift Tables (Section A.5.1.3)
- Manual And Powered Carts (Section A.5.1.4)
- Wheels/Casters For Heavy Equipment And Carts (Section A.5.1.5)
- Patient Handling Devices (Section A.5.1.6)

The Administrative Guide includes other criteria related to seating and work spaces for reference.

A "Product Evaluation Worksheet" is provided at the end of each section as forms which you may copy to use in the future. In the past, some individuals have sent similar worksheets to product manufacturers or vendors to request information on the ergonomics features of their products.

A.5.1.1 Criteria for Overhead Lifting Devices

The following criteria are for overhead lift devices such as cranes or hoists in which a load hangs from a hook, strap, or other connector (e.g., articulating arm).

Lifting devices are often critical for providing assistance in handling heavy loads. There are two major issues that must be considered when selecting a lifting device: convenience and safety.

- ***Convenience.*** If the lift device requires more time to use than manual lifting, personnel are generally reluctant to use the device.

- ***Safety.*** If the lift device itself contributes to high forces or static and awkward body postures, musculoskeletal injuries can result. Other safety issues such as guarding and alarms must be considered as well.

Additional guidance for lifting devices is also provided in AFOSH Standard 91-46, *Manual Material Handling.*

A.5.1.1.1 Ease of Use Specifications. The lift device **must be easy to use**. The lifting device should make the work easier, not harder. This means the lift device should take a minimum amount of time to move and attach. The following criteria specify convenience and ease of use requirements for the lifting device.

- The capacity of the lifting device should match the weight range for the items handled. Using a lift device with a much higher capacity than the items handled usually results in a lift device which is difficult to use and requires too much time to hook-up. This discourages the employee from using the lift device. Using a lift device with a lower capacity than the items handled creates serious safety hazards.

- Quick connect/disconnects for slings or end-effectors are critical to minimize time necessary to attach or remove the hoist from the item being handled. Safety features to prevent the item from being accidentally disconnected are critical.

- The lift device should maneuver easily and quickly without causing the operator to lose control of the load.

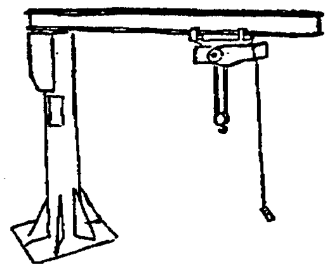
- Controls used to operate the lift device (on-off, up-down, fore-aft) should be clearly labeled, easy to understand, and easy to actuate.

- The lift device must allow the operator to perform specific handling tasks. This means the lift device must be designed for its specific applications. For instance, some tasks require careful positioning of the load prior to placement. A lift device with slow speed options is required to avoid wasting time because it keeps overshooting the target.

A.5.1.1.2 Safety Specifications. The following criteria specify safety requirements for the lifting device. Consideration of these criteria helps ensure that musculoskeletal risks are not created during use of the equipment.

- Lift devices (particularly gantry cranes and jib cranes) should not require excessive force to operate or move. Typical jib and gantry cranes are depicted in Figures A.1 and A.2.

Figure A.1
Jib Crane



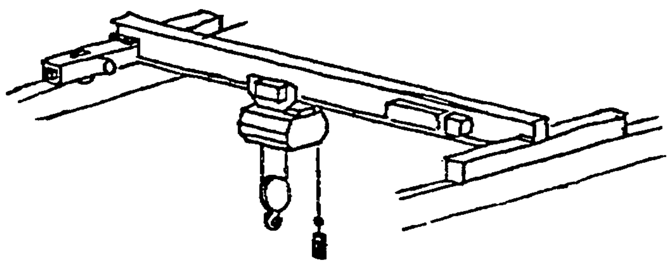


Figure A.2
Gantry Crane

- Controls should not require excessive hand forces or cause the fingers to be stretched or extended during operation.
- Controls should not require awkward wrist, arm, back, or neck postures to operate.
- The lift device should not have hard or sharp edges that could come in contact with the hand or other part of the body.
- Lift devices should meet all applicable safety requirements, which include preventing exposure to pinch/crush hazards and providing appropriate guards for all moving parts. In addition, the strength of hooks, straps, or other connectors must be designed so that the risk of unintentionally releasing/dropping the item being lifted is eliminated. Lift devices that move loads over head or that can reverse direction suddenly should be equipped with an alarm or other warning signal (such as a flashing light) to alert others that the lift device is in use. There may be other health and safety criteria not mentioned here that should be examined as a part of a complete equipment evaluation.

A.5.1.1.3 Lift Device Evaluation Worksheet

A worksheet to determine whether a lift device has basic ergonomic features is presented in Table A-1. This worksheet is provided to assist in the systematic evaluation of various lift device designs.

Table A-1
Lift Device Evaluation Worksheet

Date:	**Evaluator:**
Job:	**Type:**
Manufacturer:	**Model Number:**
Model Name:	**Price:**

Category	Parameter	Measure	Meets Criteria Yes	Meets Criteria No	N/A
Lift Capacity	Range	Capacity of the lift device should match the range of weights handled.			
Ease of Use	Overall	Time required to use the lift device should be comparable to (or less than) the time required to handle the load manually.			
	Connection/ Disconnect-ion	Connecting/disconnecting the load to/from the lift device should be quick, simple, and easy.			
	Mobility	The lift device should be quick and easy to maneuver without loss of control or stability.			
	Control understand-ability	Controls used to operate the lift device should be easy to identify, understand, and actuate.			
Capabilities	Movement Capabilities	The movement capabilities of the lift device should match the movement requirements of the task (e.g., slow speeds or incremental movement).			
Force Requirements	Transport Forces	Forces required to move or operate the lift device should be negligible.			
	Control Actuation Forces	Controls that require constant pressure to continue operation should not require a significant amount of force. Forces should be substantially below 2 lb. (0.9 kg.).			
	Exposure to hard edges	Lift devices should avoid exposing the operator to hard or sharp edges (particularly those which could press into the hand).			
Posture Requirements	Posture Requirement s	Lift devices should encourage a comfortable and neutral body posture during use. Lift device should not contribute to bent wrists, reaching, and awkward back/neck postures.			

Table A-1
Lift Device Evaluation Worksheet – cont'd

Date:			Evaluator:		
Job:			Type:		
Manufacturer:			Model Number:		
Model Name:			Price:		
Category	**Parameter**	**Measure**	**Meets Criteria Yes**	**No**	**N/A**
Safety Requirements		The lift device should prevent (at least): exposure to pinch/crush hazards, moving internal components, and falling objects.			
COMMENTS:					

A.5.1.2 Criteria for Hand Tools / Power Tools

The following major issues must be considered when developing or selecting a hand tool or power tool:

- The tool must be designed for the task(s) being performed. A tool is not considered to be ergonomically appropriate unless it performs well for specific tasks. For example, it is possible to have a tool which is very well designed for one task and poorly suited for a different task.

- The tool should be flexible enough to be useful in a variety of work situations. If a tool can be used in a number of situations, it reduces the number of tools required, thereby making the work easier.

- The tool should encourage neutral and comfortable body postures. The tool should allow the user to maintain straight wrists, prevent reaching, and encourage an upright back and head posture during performance of specific tasks.

- The tool should not require excessive forces.

- The tool should not expose the user to hard edges, excessive vibration, impact, or torque. The tool should prevent or minimize exposure to these risk factors.

A.5.1.2.1 General Principles. The following general principles apply to tool selection:

- Provide a power or semi-automatic tool for tasks that require high forces or large amounts of repetition.

- A hand tool (or non-power tool) is acceptable when the applied forces are low and the amount repetition is low.

- A tool must have a handle. Tools that do not have handles and are sized for the hand (e.g., some Allen wrenches) tend to cause hard edges which press into the hand and increase grip forces.

- A power grip (i.e., full hand) handle is generally preferred over tools which require a pinch (i.e., fingertip) grip where more than a minimal amount of force is required to perform the task.

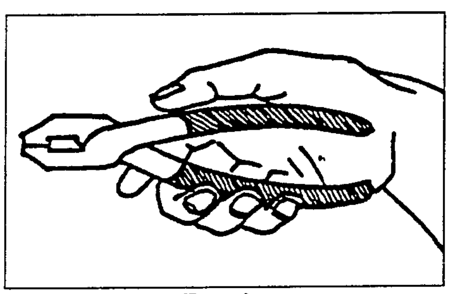
- A pinch grip is generally preferred for low-force, high-precision tasks.

- Tools should be easy to use with either the left or right hand.

- Tools should be easy to use and easy to maintain.

A.5.1.2.2 Grip Angle Guidelines for Different Tasks. The following guidelines direct the selection of a tool grip angle for particular tasks (see Table A-2 below). These guidelines are most helpful for rotary tools (such as power drills and nut drivers), but also can be applied to other types of tools (e.g., hammers, pliers).

The idea behind these guidelines is to ***bend the tool not the wrist*** as shown in Figure A.3. The task requirements determine the necessary direction of the tool. The geometry of the human body determines the necessary direction of the handle.



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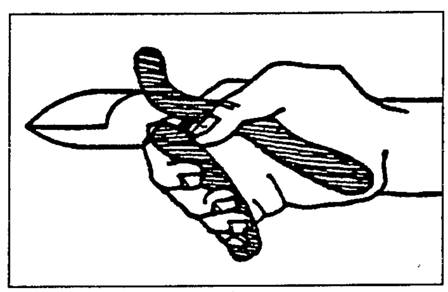

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Figure A.3
Handle Angle Criteria

- If the task being performed requires a vertical tool axis and the tool will be held at elbow height, then an in-line or straight grip will generally provide a neutral arm and wrist position.

- If the task being performed requires a horizontal tool axis and the tool will be held at elbow height, then a pistol-type grip will generally provide a neutral arm and wrist position.

Recommended grip angles for different required tool axis directions and different expected ways in which the tool would be handled are provided in Table A-2.

Table A-2
Recommended Grip Angle for Different Task Requirements

Required Tool Axis Direction	Approximate Expected Location of Tool		
	Elbow Height	*Knuckle Height*	*Shoulder Height*
Vertical	in-line/straight grip	pistol-type grip	pistol-type grip*
Horizontal	pistol-type grip	in-line/straight grip	in-line/straight grip*

*Note: Tasks which require use of tools at or above shoulder level create risk factors for the shoulder which should be addressed (i.e., modifying the task or tool, supporting the tool, providing a tool extension).

It may be beneficial if tools have multiple handles or a handle that can be oriented for different work situations. Making one tool more flexible and easy to use not only allows adaptation for multiple uses, but also reduces the number of tools needed. The handle location and orientation must allow the user to see the work without having to tilt or bend the head and/or back.

A.5.1.2.3 Criteria for Tool Forces. The following criteria provide guidelines for selecting a tool that requires minimal force to use.

- Full hand grip force required to use any tool should be less than 8 lb (3.6 kg.).

- Fingertip grip force required to use any tool should be less than 2 lb (0.9 kg.).

- The tool should allow two hands to be used when required forces are high or when additional control is needed. The tool should also allow the user to adjust and vary hand position to minimize the build-up of fatigue.

- The tool should weigh as little as possible. Generally, the tool should weigh no more than 5 lb. (2.3 kg.) without the use of a mechanical tool support device. The only possible exception would be when the tool weight is used to improve tool performance (e.g., sledge hammers). However, even though a power tool may be heavier than a hand tool version, it might be preferable as a long-term solution.

- The center of gravity of the tool should be close to (or at) the grip location. This helps to improve the balance of the tool and prevents unnecessary additional grip forces.

- Cables and hoses attached to the tool should be minimal in number and weight. Generally, hoses and cables should not increase the overall weight of the tool to more than 5 lb. (2.3 kg.) without the use of a mechanical tool support device.

- Cable and hose attachment locations should be positioned to maintain proper tool balance and minimize interference and drag while using the tool. Swivel attachments for cables can further reduce forces associated with supporting or moving the tool.

- Smooth, compressible, high-friction grip surfaces reduce grip forces required to control and use the tool.

- Handle length for torquing tools (i.e., torque wrenches, pry bars) should be proportional to the amount of force required. Longer handles on torquing tools reduce the forces required to perform the torquing task. The handle should be long enough to keep the grip forces below the force guidelines stated above.

- Force required to activate the trigger should be the minimum required to sense the actuation of the trigger and return the trigger quickly to an off position when the trigger is not actuated (typically less than 1 lb. or 0.5 kg.).

- When continuous activation of the trigger is necessary, one option is to provide a "cruise control" feature that allows the trigger to be engaged without constantly holding the trigger. As an alternative, power tools that are activated by pressure can be effective as well. For example, powered nut drivers are available that activate when sufficient pressure is applied to the bit.

- The forces required to connect/disconnect the power tool should be insignificant (e.g., to electrical outlets or air supplies).

- Plier-type tools should have a spring release mechanism to aid in opening the pliers. The spring tension should be established so the plier tool opens when not being compressed. However, the additional force required to close the pliers against that spring tension should be minimal. That is, the spring tension should not make it more difficult to close the tool.

A.5.1.2.4 Criteria for Handle Size and Shape. The following criteria specify the size and shape of the tool handle. These criteria apply for both hand and power tools.

- Grip Diameter for a full hand grip tool should be between 1" and 1.5" (2.5-3.8 cm.). This is based on the grip diameter of a small female hand. Designing for the small person's hand, in this case, makes the tool usable for the entire population. However, for special tasks, it may be desirable to customize the handle diameter by building up

the diameter of the grip handle for persons with larger hands. Compressible foam grips are available on the market to accomplish this.

- Grip Diameter for a fingertip grip tool should be between 0.25" and 0.5" (0.6-1.3 cm.).

- Plier-type tools should have a span of less than 3" (7.6 cm.). This prevents excessive span extension of the thumb and fingers to grasp the tool in the open position. The criteria is again based on the small hand.

- The handle length should be at least 4" (10.2 cm.), but 5" (12.7 cm.) is preferred. This is necessary to prevent the end of the handle from pressing in the palm of the hand (see Figure A.4). A longer handle also increases the control of the tool and reduces grip forces required. The length criteria is based on a large person's hand to ensure that the handle will be long enough for all hand sizes.

- There should be no hard or sharp edges or abrupt curves on the tool that could press into the user's hand or body. Avoid ridges or channels for individual fingers. Hard edges, which press into the hand over a period of time, can cause a number of musculoskeletal disorders to the hand or arm.

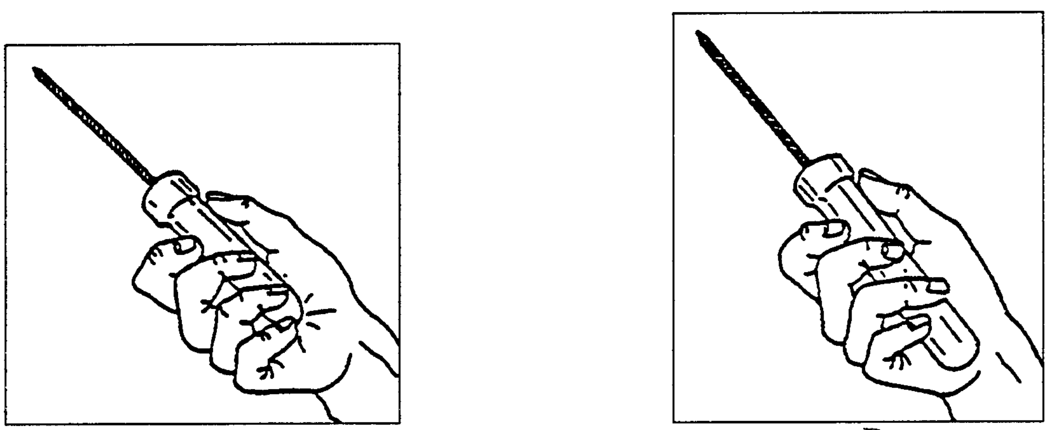

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Figure A.4
Handle Length Criteria

A.5.1.2.5 Criteria for Trigger Size and Shape. The following criteria specify the size and shape of the trigger. These criteria apply to those tools that have triggers, but some can also be applied to tools with button activators.

- Triggers and buttons should be positioned to allow activation without causing isolated extension of the fingers or the thumb. Triggers and buttons should allow the hand to remain in a resting position during actuation (see Figure A.5).

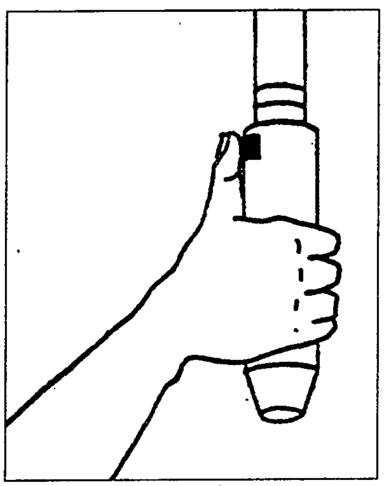
- The minimum trigger length is 1.5" (3.8 cm.), but 2" to 2.5" (5.1-6.4 cm.) is preferred. This permits two-finger activation of the trigger.

- The recommended trigger width is 0.5" to 1" (1.3-2.5 cm.). This minimizes exposure to a hard edge on the trigger and allows the entire pad of the finger to contact the trigger.

- The depth of the trigger should be 0.125" to 0.375" (0.318-0.953 cm.) to minimize extension of the index and middle fingers while pressing the trigger.

- The trigger should have a small range of movement to minimize finger movement.

- The trigger should have large smooth curves. No hard edges or points (particularly at the end of the trigger).



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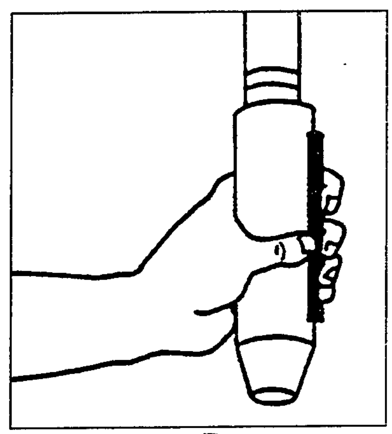

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Figure A.5
Trigger/Button Location Criteria

A.5.1.2.6 **Additional Criteria.** The following criteria specify other key features of tools.

- Handle materials should prevent heat transfer to the hand. The tool should not have bare metal handles. Handles that are coated with a rubberized insulating surface are preferred.

- Air powered tools should not cause cold air to blow on hands. Exhaust air, including exhaust from gasoline powered tools, should be directed away from the user.

- Ideally, power tools should not expose the user to vibration, torque, or impact while the tool is being used. Some vibration, however, will always be present because most power tools (e.g. drills, saws, sanders) use reciprocating or rotating frictional working ends to remove material. Few manufacturers have been successful in eliminating all perceptible vibration from these types of tools. Feeling vibration during a tool trial does not necessarily imply that the tool is not ergonomically designed. Vibration can be measured to determine whether or not prolonged use of the tool exposes the user to hazardous levels. The tool should be durable and easy to maintain to minimize the increase of vibration, torque, or impact as the tool and contact surfaces wear. If torque or impact is generated by the tool to perform the task, the maximum amount of the vibration, torque, or impact should be absorbed by using one or more of the following:

    - damping mechanisms internal to the tool
    - damping materials built into the tool handle
    - mechanical tool support mechanisms

- In general, avoid the use (or purchase) of impact tools as a power solution choice. Impact wrenches can introduce a significant source of impact stress and vibration by the very nature of the tool's torquing mechanism. In many cases, low impact, low vibration, "pulse" tools may be a solution. Pulse tools and other tools with advanced vibration dampening systems (e.g., counterbalancing mechanisms or piston-spring systems) tend to be much more expensive ($400+) than traditional power tools. In addition, if these types of tools are used to replace existing tools, users should be briefed on the tool's capabilities and unique performance characteristics. The "feel" is different and, without a briefing, many users may find the tool unacceptable when it's capabilities may actually be a direct match to those of the traditional tool.

- Exposure to working levels of vibration over the 50-200 Hz frequency range should be minimal. Measurement of vibration and impact requires special equipment and is generally considered to be best performed as a part of Level II Ergonomics Analysis. For additional information, refer to ANSI Standard S3.34.

- Exposure to torque should be minimized. Torque can be measured with a torque wrench. Maximum acceptable torque for an in-line power tool is 2.4 ft-lb. (3.2 Nm). For a pistol-shaped power tool, the maximum acceptable torque is 6.6 ft-lb. (9.0 Nm) [Joseph and Long (1991)]. One of the purposes of shut-off mechanisms in torquing

tools is to prevent the user from being exposed to torque levels in excess of these maximums. These guidelines are provided as maximum torque levels for worst-case exposure scenarios (e.g., as a nut is "torqued" into final, or tight position).

A.5.1.2.7 Hand Tool/Power Tool Evaluation Worksheet. Table A-3 presents a worksheet to determine whether a hand tool/power tool has basic ergonomic features. This worksheet is provided to help in the systematic evaluation of various tool designs.

Table A-3
Hand Tool/Power Tool Evaluation Worksheet

Date:	**Evaluator:**
Job:	**Type:**
Manufacturer:	**Model Number:**
Model Name:	**Price:**

Category	Parameter	Measure	Meets Criteria Yes	Meets Criteria No	N/A
General	Handiness	Tool should be easily used with either the left or right hand.			
	Repetition	Tool should minimize repetitive movements.			
	Ease of Use	Tool should be easy to use.			
	Ease of Maintenance	Tool should be easy to maintain.			
Grip Angle	Wrist and Arm Posture	Handle angle and location should allow a straight wrist and neutral arm position while the tool is being used.			
	Back and Neck Posture	Handle angle and location should allow the user to see the work without having to tilt or bend the head or back.			
Force Requirements	Activation Forces	**Full hand** grip forces required to use tool should be less than 8 lb. (3.6 kg.)			
		Fingertip grip force required to use tool should be less than 2 lb.(0.91 kg.)			
	Two hand activation	Tool should allow two hands when applied forces are high or when additional control is needed.			
	Tool Weight	Tool (and associated cables/hoses) should weigh less than 5 lb. (2.3 kg.) or be mechanically supported.			
	Tool Balance	Tool's center of gravity should be close to or at the grip location.			
	Cable/Hose Attachment	Cables and hoses should be attached to minimize interference and drag.			
	Handle Surface	Grip surfaces should be high friction and slip-resistant.			
		Grip surfaces should be compressible.			

Table A-3
Hand Tool/Power Tool Evaluation Worksheet – cont'd

Date:	**Evaluator:**
Job:	**Type:**
Manufacturer:	**Model Number:**
Model Name:	**Price:**

Category	Parameter	Measure	Meets Criteria Yes	No	N/A
Force Requirements Cont'd	Handle Shape	There should be no hard/sharp edges or abrupt curves that the contact user's hand or body. Avoid ridges or channels for individual fingers.			
	Handle for Torquing Tools	For torquing tools, the handle should be long enough to prevent grip forces above 8 lb. (3.6 kg.)			
	Trigger Force	Force required to activate the trigger should be insignificant (typically less than 1 lb. or 0.5 kg.)			
	Trigger Function	Tool should avoid continuous activation of a trigger.			
	Connection Force	Force required to connect/disconnect the power tool should be insignificant.			
	Spring Release (Plier-Type Tools)	Plier-type tools should have a spring release mechanism. The spring tension should be minimal.			
Handle Size	Grip Diameter	Grip Diameter for a full hand grip tool should be between 1-1.5" (2.5-3.8 cm.).			
		Grip Diameter for a fingertip grip tool should be between 0.25-0.5" (0.6-1.3 cm.).			
		It should also be possible to increase the diameter of the handle if needed.			
	Handle Span on Plier-Type Tools	Plier-type tools should have a span of less than 3" (7.6 cm.).			
	Total Grip Length	4" (10.2 cm.) minimum, 5" (12.7 cm.) preferred			
Trigger/ Buttons	Location	Triggers and buttons should be positioned to prevent extension of fingers or the thumb.			

Table A-3
Hand Tool/Power Tool Evaluation Worksheet

Date:			**Evaluator:**		
Job:			**Type:**		
Manufacturer:			**Model Number:**		
Model Name:			**Price:**		
Category	**Parameter**	**Measure**	**Meets Criteria Yes**	**No**	**N/A**
	Shape	Trigger should have large smooth curves. No hard edges or points (particularly at the end of the trigger).			
	Length	1.5" (3.8 cm.) minimum, 2-2.5" (5.1-6.4 cm.) preferred			
	Width	0.5-1.0" (1.3-2.5 cm.).			
	Ridge Depth	0.125" - 0.375" (0.318-0.953 cm.)			
	Range of Movement	Trigger should have a small range of movement.			
Misc.	Heat Conduction	Tool handle should be coated or rubberized (tool handles should not be bare metal)			
	Routing of Exhaust Air	Exhaust air should be routed directly away from user.			
	Torque/ Impact	Tool should not expose the user to excessive torque or impact.			
	Vibration	Tool should not expose the user to excessive vibration.			
Comments:					

A.5.1.3 Criteria for Height-Adjustable Lift Tables.

The following issues and criteria need to be considered when selecting height-adjustable lift tables. Height-adjustable lift tables are used to correctly position work objects. Lift tables can minimize bending and reaching when loading or offloading materials on a pallet, serve as temporary material storage during processing, or facilitate the transfer of materials between storage shelves by changing a manual lift to a slide.

There are several major types of lift tables available. They differ in terms of elevating mechanism (e.g., pneumatic, air bladder, spring loaded, and hydraulic), ease of movement (e.g., stationary or mobile lift tables as illustrated in Figures A.6 and A.7), and integration with other materials handling equipment (e.g., pallet jack or fork truck).

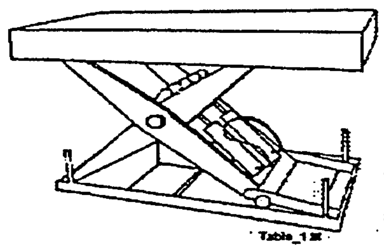


Figure A.6
Stationary Height-Adjustable Lift Table

Height-adjustable lift tables help decrease the stress and fatigue associated with manual materials handling of light weight items (less than 50 lb. or 22.7 kg.) by creating optimal back and shoulder positions. Using a lift table does not completely eliminate the risk of injury since, in many cases, the item's weight or size is greater than can be handled safely. Therefore, it is often recommended that height-adjustable lift tables be used with mechanical lifting devices.

The following issues should be considered when selecting or designing a height-adjustable lift table:

- A lift table should allow all personnel to palletize materials in a neutral and comfortable body posture by preventing reaching, bending, and twisting.
- A lift table must fit into the space allowed.
- A lift table's mechanisms and contact point should be guarded or padded to prevent exposure to pinch points, crush hazards, or trip hazards.

Additional guidance for lift tables and other lifting devices is provided in AFOSH Standard 91-46, *Manual Material Handling.*

A.5.1.3.1 Determining Capacity. The lift table should be able to handle a range of loads with capacity exceeding that of the heaviest expected weight. Additionally, the load range will help determine the most suitable type of lift table. For instance, if the loads being handled will remain relatively constant, a spring-loaded lift table will work very well, as the lift's performance is dependent upon the weight of the load placed on it. However, if there will be a wide variation in loads being handled, a hydraulic or pneumatic lift table will work better.

A.5.1.3.2 Determining the Appropriate Height Range. The table's range of adjustability is dependent on the size and overall stacking height of the material being handled. The overall goal is to keep the lifting height between 30" and 36" (76.2-91.4 cm.) from the floor. If this is not possible, the maximum range of lifting heights should be between 25" and 50" (63.5-127 cm.). This range allows for 90 percent of the work population to handle items between knuckle and shoulder height.

Typical lift tables compress to a 10" (25.4 cm.) thickness. Thus, when using 5" (12.7 cm.) pallets, the material's total thickness should not be greater than 35" (88.9 cm.) to meet the 50" (127 cm.) guideline. If highly repetitive stacking above 35" (88.9 cm.) is currently performed, consider lift tables that can be lowered into the floor or using a fork truck.

A.5.1.3.3 Control Location and Design. The control type and location should also be considered when purchasing lift tables. Many lift tables are controlled by hand-held, foot, and automatic weight sensing controls. The factors that influence decisions about controls include:

- Frequency of the lift
- Need to adjust the lift table with hands full
- Maneuverability requirements of the workstation

If personnel need to readjust the lift table while both hands are full, then a foot control may be necessary. For tasks that require repetitive lifting, automatic weight sensing controls are desirable, while hand controls work well for low frequency lifting tasks.

A.5.1.3.4 Lift Table Mobility. The ability for lift tables to transfer palletized loads between work areas varies. Some can elevate and move loads, while others are only able to lift and lower items (see Figure A.7).

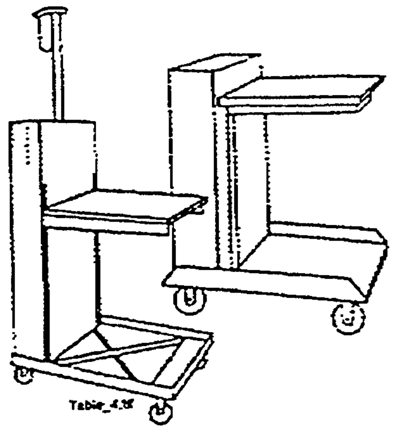


Figure A.7
Mobile Height-Adjustable Lift Table

A.5.1.3.5 Turntable Considerations. A turntable is an excellent addition to a lift table for high-volume palletizing tasks or when loading or offloading any pallet, as it allows for accessibility from all sides. Although turntables work very well in areas with tight space constraints, there must be enough space to allow full rotation. Additionally, the turntable's rotating mechanism should be guarded.

A.5.1.3.6 "Floor-Level" Vs. Standard Lift Tables. A concern with "floor-level" lift tables is that the lifting mechanism is located on one side, thereby preventing access on one or more sides. Additionally, turntable mechanisms are not possible on "floor-level" lift tables because the lift mechanism obstructs the rotation. Turntable options are only possible if the lift table is sunk into a pit. Thus, it is more advisable to purchase standard lift tables as their ability to interface with other materials handling equipment and their turntable options are greater than those of "floor-level" lift tables.

A.5.1.3.7 Lift and Tilt Tables. Tables that lift and tilt are normally used to reduce awkward back positions when the task requires placing or retrieving items from large and deep containers. The container size and orientation can also cause awkward back positions. Providing a table that lifts and tilts may not substantially eliminate these stressors. Further stressor reductions can be achieved by modifying the container. These modifications can include:

- Reducing the box size.
- Placing a fold-down flap on one or, preferably, both sides of a large container.

- Designing the container for side loading and access.

A.5.1.3.8 Height-Adjustable Lift Table Evaluation Worksheet. Table A.4 presents a worksheet to determine whether a height-adjustable lift table has basic ergonomic features. This worksheet is provided to assist in the systematic evaluation of various products.

Table A-4
Height-Adjustable Lift Table Evaluation Worksheet

Date:			**Evaluator:**		
Job:			**Type:**		
Manufacturer:			**Model Number:**		
Model Name:			**Price:**		
Category	**Parameter**	**Measure**	**Meets Criteria Yes**	**No**	**N/A**
Overall Capabilities	Lift Capacity	Capacity of the lift table should match the range of loads handled.			
	Range of the Height Adjustment	The range of adjustment should allow the loads to be positioned between 30"-36" (76.2-91.4 cm.) or at worst between 25-50" (63.5-127 cm.).			
	Stationary Locks	It should be possible to lock the lift table in position during loading and unloading.			
Ease of Use	Overall	Raising or lowering the table should be able to be completed within the work cycle and should not increase task time significantly.			
	Mobility	The mobile lift tables should be quick and easy to maneuver without loss of control or stability. Stationary lift tables should be transportable using a fork truck or pallet jack without major reconfiguration.			
	Control understand-ability	Controls used to operate the lift table should be easy to identify, understand, and actuate.			
	Control Location	Foot operated controls should be used when both hands will be occupied. Automated control of lift table height using a photo-eye device is recom-mended for highly repetitive tasks.			
Force Requirements	Lift table transportation	Forces required to manually push the lift table should be less than 25 lbs. (11.3kg.) Negligible forces are preferred unless some inertia is needed for control.			

Table A-4
Height-Adjustable Lift Table Evaluation Worksheet cont'd

Date:			**Evaluator:**		
Job:			**Type:**		
Manufacturer:			**Model Number:**		
Model Name:			**Price:**		
Category	**Parameter**	**Measure**	**Meets Criteria Yes**	**No**	**N/A**
	Turntable Rotation	Forces required to manually rotate the turntable table should be less than 25 lbs. (11.3kg.) Negligible forces are preferred unless some inertia is needed for control.			
	Control Actuation Forces	Controls that require constant pressure to continue operation should not require a significant amount of force. Forces should be substantially less than 2 lb. (0.9 kg.).			
Posture Requirements	Overall	Lift tables should encourage a comfortable and neutral body posture during use. The lift table should not contribute to bent wrist, reaching, and awkward back/neck postures.			
	Reach Requirements	Personnel should be able to directly access materials without having to reach across obstacles.			
	Toe Clearance	The lift table should have at least 8" (20.3 cm.) of toe clearance at all access points to prevent jamming of toes.			
Safety Requirements	Moving Internal Components	Lift tables should not have any exposed moving internal components that could create pinch or crush hazards. All moving internal components that could result in a pinch or crush hazard should be guarded.			
	Accidental Activation	Controls should have features built-in to prevent accidental activation of the lift table.			

Table A-4
Height-Adjustable Lift Table Evaluation Worksheet – cont'd

Date:			**Evaluator:**		
Job:			**Type:**		
Manufacturer:			**Model Number:**		
Model Name:			**Price:**		
Category	**Parameter**	**Measure**	**Meets Criteria Yes**	**No**	**N/A**
	Hard/Sharp Edges	Lift table should not have any exposed hard or sharp edges that could result in a cut or scrape			
	Protrusions/ Cabling	Lift table should not have any exposed blunt or pointed protrusions or barriers that could be a source of a contusion, scrape, or trip. For instance, hoses and cabling should be designed and mounted to minimize the risk of a trip hazard.			
Optional Features	Floor-Level Capabilities	In the floor-level position, a pallet jack should be able to place or remove a pallet without obstacles, interference, or high forces.			
	Lift and Tilt Capabilities	It is preferable if the tilt mechanism can be adjusted independently from the lift mechanism.			
	Turntable	Round turntables are generally preferred to square ones.			
Comments:					

A.5.1.4 Criteria for Manual and Powered Rolling Carts.

The following criteria are for manual and powered rolling carts (walk-behind powered carts only). Rolling carts should be used when transporting loads that would otherwise be lifted and carried (see Figures A.8 and A.9).

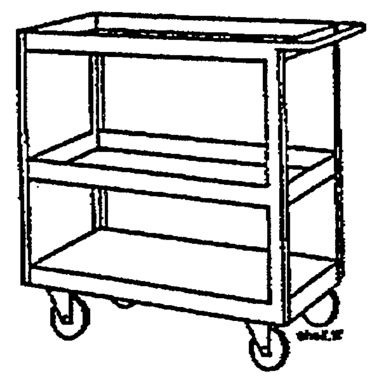


Figure A.8
Shelf-Style Rolling Cart

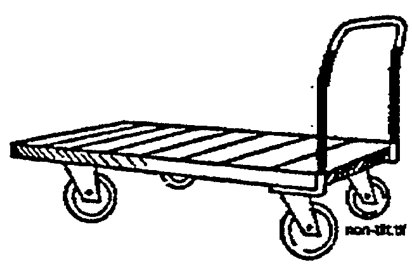


Figure A.9
Flat-Bed Rolling Cart

A.5.1.4.1 Reducing Push Forces. One of the most important considerations for the selection of a rolling cart is the minimization of push forces. The most important strategies for accomplishing this included:

- Increasing the wheel diameter.
- Selecting the appropriate wheel material and bearings for the floor surface being used.
- Reducing the weight of load.

- Maintaining wheels at scheduled intervals.

Additional information on reducing push forces is provided in Section A.5.1.5.

A.5.1.4.2 Wheel Configuration. For a typical four-wheel configuration, it is recommended that all four wheels have a swivel-lock feature that prevents inadvertent turning when handling carts. Ideally, the locking mechanism should be activated by foot pressure. (Please refer to A.5.1.5.5 for more information)

Optimal wheel configuration depends upon the handling situation. For example, to maintain control when pushing down a corridor, it is generally best to have two wheels swivel-locked and two wheels unlocked, with the swivel-locked wheels located on the opposite end from the pushing end. If the task requires maneuvering in tight quarters, then all four wheels should be in swivel mode.

For heavily used carts, such as patient stretchers, a five-wheel configuration is recommended. (Note: the fifth wheel is located in the cart's center and is locked by a hand control). When the cart is being pushed, the four corner wheels are in swivel-mode, and the fifth wheel is lowered to provide stability.

Rolling locks (i.e., locks that prevent movement by compressing a metal coupling against the tread) are necessary when storing carts on inclined surfaces, when loading and offloading contents, or when cart movement could create a safety concern.

A.5.1.4.3 Cart Handles. Handles that allow a "full-hand grip" are generally preferred. A "full-hand grip" means that the operator can grasp the handles with the thumb overlapping fingers. These types of handles are essential in the following situations:

- Push forces are significant
- Control of the cart is crucial
- Frequency of use is high

The grip diameter for a "full-hand grip" handle should be between 1" and 1.5" (2.5-3.8 cm.). This is based on the grip diameter of a small female hand. Designing for the small person's hand, in this case, makes the handle usable for a majority of the population.

There should be at least 4" (10.2 cm.) hand clearance between the handle and the mounting surface. This is based on the hand width of a large male hand. This provides adequate hand clearance for a majority of the population.

There should be no hard/sharp edges or abrupt curves on the handle that could press into the user's hand or body. Avoid ridges or channels for individual fingers. As a general guideline, handles should be mounted at least 36" (91.4 cm.) above the floor. Vertical loop handles designed to accommodate different sized individuals should be between 36" and 50" (91.4-127 cm.) above the floor. The handle should also be mounted close to the vertical center of gravity of the cart (i.e., the higher the center of gravity, the higher the handle height).

A.5.1.4.4 Shelf Requirements. Shelves are a common method for storing materials on carts. Multiple shelves are used to increase the capacity for storing smaller materials on the cart in an organized and stable manner. Task requirements and volume of materials to be handled should determine the number of shelves.

Shelf height will be determined by the size of the materials being handled. The need for visual access and the stability of the cart should also influence shelf heights. For instance, it may be desirable to place shelves higher to minimize bending to access materials. However, the size of the cart may need to be increased to maintain cart stability. Of course, there must be adequate spacing between shelves to allow placement of the largest items. In some cases, one or two shelf spaces can be allocated to larger items, if appropriate.

A.5.1.4.5 Powered Carts. Powered carts are often used for handling heavy loads or transporting loads over long distances. The guidelines for determining the need for a powered cart are listed below. A powered cart should be considered for applications where:

- The weight of load exceeds 1000 lb. (454 kg.).
- The average distance traveled exceeds 100 ft (30.5 m.).
- The frequency of transfers exceeds 100 per day.

It is important to remember that the weight of load is not equal to the forces required to push that load. There are many factors which influence push forces. Examples include:

- Wheel size.
- Wheel composition.
- Wheel shape.
- Bearing type.
- Wheel maintenance.
- Floor composition.
- Floor cleanliness and maintenance.
- Travel speed.
- Space availability.
- Load weight.

A.5.1.4.6 Cart Evaluation Worksheet. Table A-5 presents a worksheet to determine whether a cart has basic ergonomic features. This worksheet is provided to assist in the systematic evaluation of various products.

Table A-5
Cart Evaluation Worksheet

Date:	**Evaluator:**
Job:	**Type:**
Manufacturer:	**Model Number:**
Model Name:	**Price:**

Category	Parameter	Measure	Meets Criteria Yes	No	N/A
Overall Capabilities	Overall	The cart minimizes push forces and optimizes control on all surfaces upon which the cart will be used.			
	Height for Visual Clearance	To allow some visual access, the loaded cart should not be higher than 50" (127 cm.). A higher cart will require some individuals to look around the cart while pushing.			
	Mobility	The lift device should be quick and easy to maneuver without loss of control or stability.			
Wheels	General Requirements	See Wheel/Caster Evaluation Worksheet for additional information			
	Configuration	All wheels have swivel-lock capability.			
		Swivel locks should be able to be engaged and disengaged by stepping on buttons			
Handles	Handle Existence	Cart should have "full-hand grip" handles when: • push forces are significant • control is critical • frequency of use is high Otherwise, handles integrated into the body of the cart are an alternative			
	Handle Orientation	Handles are vertically oriented (in most situations, horizontal handles are also acceptable and may be preferred in specific circumstances)			
	Handle Location	Handles are located on all four corners of the cart (expect where task or environment prohibit)			
	Handle Diameter	1-1.5" (2.5-3.8 cm.).			

Table A-5
Cart Evaluation Worksheet – cont'd

Date:			**Evaluator:**		
Job:			**Type:**		
Manufacturer:			**Model Number:**		
Model Name:			**Price:**		
Category	**Parameter**	**Measure**	**Meets Criteria Yes**	**No**	**N/A**
	Hand Clearance Under Handle	There should be at least 4" (10.2 cm.) hand clearance between the handle and the mounting surface.			
	Handle Length	Minimum 5" (12.7 cm.). Longer handles are generally preferred to increase flexibility.			
	Handle Heights	Handles should generally be mounted at 36" (91.4 cm.) or higher. The handle should be mounted close to the vertical center of gravity of the cart. The higher the center of gravity, the higher the handle. Vertical handles should range in height between 36"-50" (91.4-127 cm.).			
Shelves	Shelf Design	Shelves should have slightly raised edges if rolling or sliding materials are a possibility (Note: all edges should be rounded). Task requirements and materials being handled should determine the surface material of the shelves.			
	Number of Shelves	Task requirements and volume of materials being handled should determine the number of shelves.			
	Shelf Heights	The size and volume of the materials being handled should determine the shelf heights. Shelf heights should also minimize bending and reaching, provide adequate visual access, and maintain cart stability when fully or partially loaded.			
Force Requirements	Transport Forces	The forces required to manually push the cart			

		should be less than 25 lbs. (11.3 kg.). Negligible forces are preferred unless some inertia is needed for control.			
Posture Requirements	Posture Requirements	The cart should encourage a comfortable and neutral body posture during use. Lift device should not contribute to bent wrists, reaching, and awkward back/neck postures.			

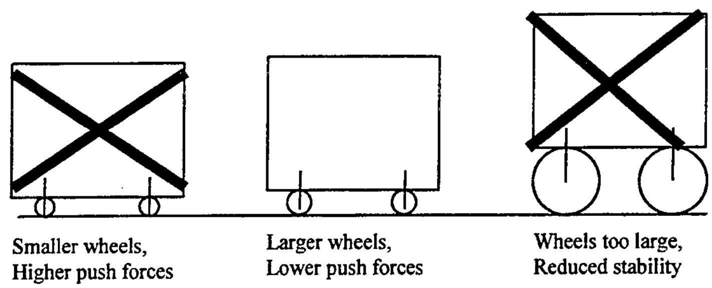
Table A-5
Cart Evaluation Worksheet – cont'd

Date:			Evaluator:		
Job:			Type:		
Manufacturer:			Model Number:		
Model Name:			Price:		
Category	**Parameter**	**Measure**	**Meets Criteria Yes**	**No**	**N/A**
Safety Requirements		The cart should prevent (at least): exposure to pinch/crush hazards, moving internal components, and falling objects.			
	Hard/sharp edges	All edges should be round. There should be no exposed hard or sharp edges.			
Other Features	Powered Carts	A powered cart should be considered for handling applications where: • The weight of load exceeds 1000 lb. (454 kg.);or, • The average distance traveled exceeds 100 ft. (30.5 m.); or The frequency of transfers exceeds 100 per day.			
Comments:					

A.5.1.5 Criteria for Wheels/Casters for Heavy Equipment and Carts

Proper wheel and caster design can reduce push forces associated with transporting carts, heavy equipment, and other mobile materials. If push forces are critical in the manual handling task, selecting wheels that have been designed and tested to reduce push forces is a good strategy.

A.5.1.5.1 Wheel Size. Small wheels are a common cause of excessive push forces in carts (see Figure A.10, Cart A). In general, the larger the wheel diameter, the less push forces are required. Larger wheels also handle obstructions and debris more easily (see Figure A.10, Cart B). However, if the wheel diameter is too great compared to the distance between wheels, than the stability of the cart is reduced (see Figure A.10, Cart C). Wheel diameter should be substantially less than the distance between centers of the wheels.



A B C

Figure A.10
Impacts of Wheel Size on Stability

The preferred range of wheel diameters for most manually pushed carts and equipment is 4" to 8" (10.1-20.3 cm.), depending upon the weight of the load and the size of the cart. For large carts with heavy loads, 8" (20.3 cm.) is recommended. For small, light-duty carts, 4" to 5" (10.1-12.7 cm.) is recommended.

A.5.1.5.2 **Wheel Width.** The wheel width is also dependent upon the job or task requirements. Wider wheels generate more friction with the floor (particularly when turning). Thinner wheels tend to concentrate forces (weight of the load) over a smaller surface area. Generally, thinner wheels have to be made of harder material to slow wear and tear.

As the load becomes heavier, a wider wheel generally becomes more favorable to distribute the load over a larger surface area. Thin wheels work well for relatively light loads (as in small carts).

A.5.1.5.3 **Wheel Shape.** The shape of the wheel profile falls within two preferred patterns (see Figure A.11, Profile A and B): mostly flat on the bottom with rounded sides (better for heavier loads, see Profile A) or almost completely rounded with very little flat (better for lighter loads, see Profile B).

The profile of the wheel should generally not be perfectly square (see Profile C). This increases friction (particular when turning) and, thus, requires more push forces to move the cart.

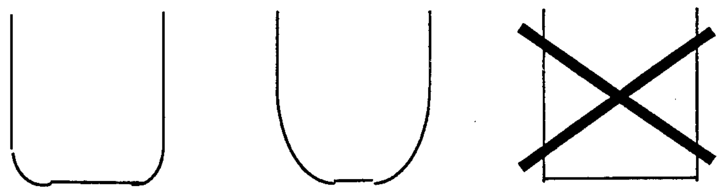


Figure A.11
Wheel Profile Characteristics

A.5.1.5.4 Wheel Composition. Wheels for casters can be made from a number of materials. Rubber and specialized synthetic plastics are the most common. In most cases, it is advisable to avoid wheels that are either very soft or very hard. Very soft wheels tend to create higher friction with the floor and increase push forces. Very hard wheels tend to be obstructed by small particles on the floor. An optimum balance between these extremes is generally the type of wheel material that minimizes push forces (e.g., the material used for in-line skate wheels).

It is important that wheel material and design be compatible with the floor surface(s) being used. For example, if a wheel's bearings and materials were selected for use on concrete surfaces, it may be difficult to push this cart on carpet. Conversely, if a wheel's bearings and materials were selected for carpet, the cart may be easy to push on concrete, but may be difficult to control.

Inflatable wheels are effective for handling very heavy loads, but increase push forces unnecessarily for lighter loads. Inflatable wheels are effective on rough terrain, but are not as effective on hard floors. Like all wheels made of softer material, inflatable wheels have the disadvantage of increased friction with the ground.

There are several types of bearings used in wheel design; ball bearings, sleeve bearings, and precision bearings. The best bearings for a particular application depend upon many factors, including the load, the floor condition, and the frequency of use. Consult the wheel manufacturer for guidance on the best bearing to use for a given application.

A.5.1.5.5 Swivel-Lock Capabilities. It is recommended that all wheels have a swivel-lock feature. This feature allows the user to lock wheels in a fixed orientation that permits movement of the cart or piece of equipment in a straight line for maximum control and stability.

The swivel feature allows the caster to be maneuverable in tight spaces. The wheel should swivel and "follow" the movement of the cart by having the center of the wheel offset from the center point of loading on the caster. This reduces forces required to initiate movement.

It is important that the swivel on wheels is easy to lock and unlock by simply stepping on the lock mechanism. In other words, personnel should not have to get down on their hands and knees to lock or unlock the wheels.

A swivel-lock is different from a rotation lock, which prevents the wheel from turning. Locks on the free rolling of wheels are important for specific cart applications such as when carts are stored on inclined surfaces, when the cart must be stabilized during loading and offloading, or when rolling carts are a potential safety concern.

A.5.1.5.6 Wheel/Caster Evaluation Worksheet. Table A-6 presents a worksheet to determine whether wheels/casters have basic ergonomic features. This worksheet is provided to help systematically evaluate various products.

Table A-6
Wheel/Caster Evaluation Worksheet

Date:			**Evaluator:**		
Job:			**Type:**		
Manufacturer:			**Model Number:**		
Model Name:			**Price:**		
Category June		**Measure**	**Meets Criteria Yes**	**No**	**N/A**
Overall Capabilities	Basic Requirement	The wheel should minimize push forces and optimize control on all surfaces upon which the wheel will be used.			
	Wheel Composition	The wheel material and bearings should match the handling application and environment. In general, very soft or very hard materials should not be used.			
	Durability	The wheel should be durable, long lasting, and easy to maintain.			
Wheel Dimensions	Diameter	Wheel diameter should minimize push forces while maintaining stability. Wheels should be 4-8" (10.1-20.3 cm.) in diameter for most manually pushed carts (depending upon the weight of the load and the size of the cart) Wheel diameters for powered carts and trucks depend heavily on the load, size of cart, and floor surface.			

Table A-6
Wheel/Caster Evaluation Worksheet – cont'd

Date:					
Job:		**Type:**			
Manufacturer:		**Model Number:**			
Model Name:		**Price:**			
Category June		**Measure**	**Meets Criteria Yes**	**No**	**N/A**
	Width	The wheel material and bearings should match the load, handling application, and environment.			
	Shape/Profile	The wheel shape should match the load, task, and environment.			
Features	Swivel	The wheel should swivel and "follow" the movement of the cart by having the center of the wheel off-set from the center point of loading on the caster.			
	Swivel-Lock	The wheel should have a swivel-lock feature that allows the wheel to be locked in a fixed orientation while rolling freely. This mechanism should be easily controlled with the foot.			
	Rotation-Lock	A rotation lock is an optional feature that may be critical for specific applications.			
Comments:					

A.5.1.6 Criteria for Patient Handling Devices.

There are several factors that make patient handling difficult work. Adult patients typically weigh more than 100 lb. (45.4 kg). The postures required by staff members to perform transfers are often very awkward and patients are often difficult to grasp. In addition, patients may not be fully in control of their bodies during transfers. Due to these factors, manual lifting of patients on a regular basis should be eliminated whenever possible. Even children can present severe lifting situations when the staff member is in an awkward posture. "Body mechanics" and lifting technique should not be considered primary control measures for preventing WMSDs. Mechanical assistance should be the primary control whenever possible. The overall goal of using these devices is to move toward a "zero-lift" patient care environment in which the staff member does not perform manual lifting of patients.

Many types of devices that can be used to assist in transporting or repositioning patients in a medical environment, including:

- Mechanical lift assist devices.
- Horizontal transfer devices.
- Gurneys/stretchers.
- Wheelchairs/shower chairs.
- Lifting belts.

The following sections provide criteria for these devices. Please refer to Sections A.5.1.4 and A.5.1.5 for additional criteria on rolling devices and wheels.

A.5.1.6.1 Mechanical Lift Assist Devices. Many types of mechanical lift assist devices are available. This discussion focuses on those types of lift devices that are most commonly used and recommended for routine patient transfer tasks, including bed-wheelchair transfers, bed-toilet transfers, wheelchair-toilet transfers, emergency lifts from floor, etc. Other types of specialty lift devices are available for specific tasks, such as ambulation and physical therapy. Although these specialty lift devices are not discussed in detail, the Patient Handling Device Evaluation Worksheet (Table A-7) maybe used in their evaluation.

There are two basic types of sling lift devices available: sitting sling lifts (Figure A.12) and standing sling lifts (Figure A.13). The standing/upright lifts are quicker and easier to use because the sling is secured only around the patient's upper body, rather than underneath the entire patient. Standing sling lifts can facilitate patient toileting more efficiently than a sitting sling lift in most cases. However, standing lift devices generally only function for those patients with some upper body functionality and the ability to bear some portion of their body weight on their legs. Sitting sling lifts are necessary for more dependent patients.

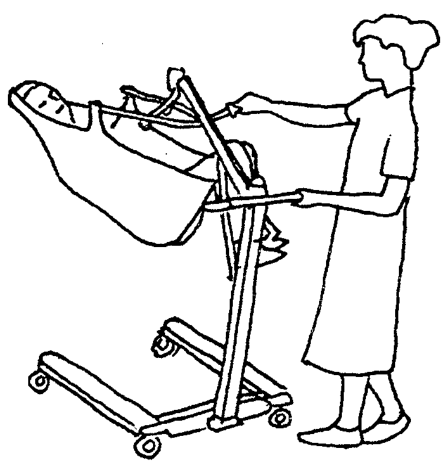


Figure A.12

Sitting Sling Lift

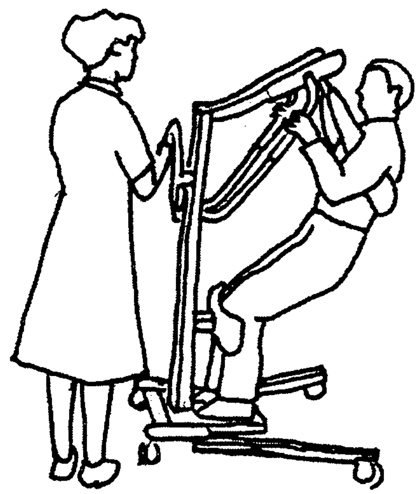


Figure A.13
Standing Sling Lift

The following major issues must be considered when selecting a mechanical lift assist device.

- Assure the comfort, stability, and safety of the patient in the sling. Both the actual safety/stability and the patient's perception of safety/stability are important. To this end, the attachments for the sling must be secure. There should be no opportunities for sling attachments to become disengaged during transfer.

- Assure that the lift device is stable throughout the transfer by having a wide base that does not tip even if the patient is moving.

- Provide for safe operation by one person (particularly if one person performs the corresponding manual task).

- Assure that the lift device can fit into the space required by the task. The lift device should be able to access the origin and destination points of the transfer. For instance, a lift device that is to be used for patient toileting should fit into existing bathrooms. In addition, the lift device should be accessible to beds, wheel chairs, and geriatric chairs. This is often accomplished via leg supports that can slide under beds and straddle various types of chairs.

- Assure that the lift device does not take significantly more time to use than the manual procedure. Accessible storage and adequate numbers of lift devices for the demand is critical.

- Prevent pinch or crush points on the lift device for the patient or the staff member.

- Provide lift devices that can lower to floor level if emergency lifts of patients from floor level may become necessary.

- Consider integrating a scale into the lift if patient weighing is required routinely. Combining the tasks of weighing and transferring the patient, effectively eliminates one lift per patient.

A.5.1.6.2 Horizontal Transfer Devices. There are several types of devices that can be used for transferring patients from one horizontal surface to another, or to reposition a patient on a bed or surgical table. The primary function of these devices is to reduce the sliding friction between the patient and the surface, thereby reducing the forces required to transfer the patient. Without these devices, staff members must simultaneously lift and slide the patient. Several types of sliding devices have been created (with several combinations and variations). These include:

- Sliding boards - large, stiff, flat boards typically made of a low friction plastic material.
- Roller boards - rollers covered with a flexible material.
- Sliding tubes - a flexible, low friction, plastic material manufactured in the shape of a flat tube or sheet.

Figures A.14, A.15, and A.16 illustrate these three devices. In general, stiff sliding boards are preferred for bed-stretcher transfers because they provide a safer transition between the two surfaces. Flexible sliding tubes work well for patient repositioning tasks (such as moving patients up in bed). Roller boards are used chiefly in surgical, ER, and birthing centers (primarily due to the compact size). However, sliding boards are more comfortable for the patient and are preferable if space constraints allow.

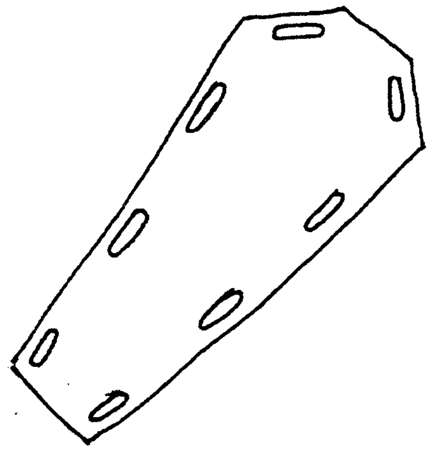


Figure A.14
Sliding Board

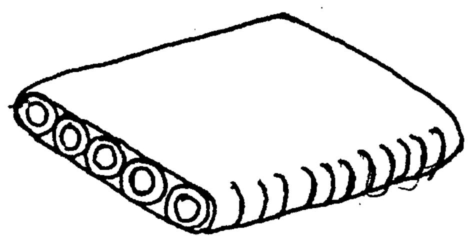


Figure A.15
Roller Board

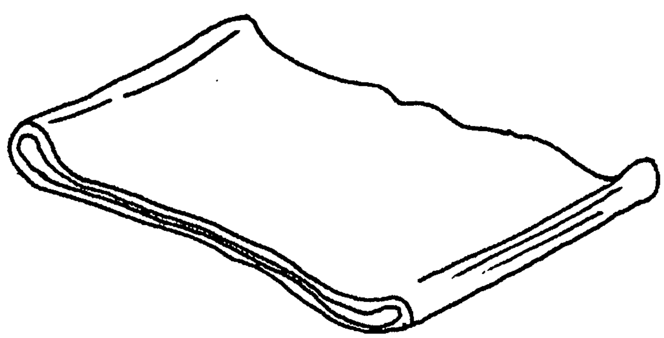


Figure A.16
Sliding Tube

All of these devices generally require the use of a draw sheet to function properly with minimal risk to the patient and staff. Section A.5.2.12.2 provides additional information.

In horizontal transfer devices, the following features are beneficial:

- Assure patient comfort by minimizing the thickness of the device. Devices that are less than 0.25" (0.64 cm) are preferred. To minimize the amount of patient movement required for placement and removal.

- Provide a surface that minimizes frictional forces.

- Provide a surface that is easy to clean.

- Support the entire patient's body when possible. Different sizes will be required for children and adults.

- Provide sufficient capacity to support the weight of the heaviest patient.

- Use materials which are light in weight (i.e., less than 5 lb.).

A.5.1.6.3 Gurneys/Stretchers. Gurneys and stretchers are devices for transferring patients long distances horizontally. For this discussion, the terms, "gurney" and "stretcher" are used interchangeably. Since these devices are in many ways similar to rolling carts, please refer to Sections A.5.1.4 and A.5.1.5 for additional information. This section focuses on those issues unique to gurneys and stretchers.

Gurneys should have the following features:

- Easy rolling capability on the highest friction surface (e.g., carpet).

- Multiple modes of movement (e.g., in long hallways and tight spaces). Long distance movement requires that one or more wheels are swivel-locked to provide easily controlled linear movement. Movement in tight spaces is facilitated when no wheels are swivel-locked. It should be easy and quick (such as with a single foot pedal or hand control) to switch between these modes.

- Easily adjustable side rails which can be locked into position thereby making inadvertent lowering difficult or impossible.

- Easily adjustable heights, allowing efficient patient transfer to fixed height tables (e.g., x-ray).

- Easily loaded into ambulances without exerting high forces or requiring heavy lifting. Forces that are required to load/unload the device from an ambulance should not exceed 50 lb.(22.7 kg.) per person (below 25 lb. (11.3 kg.) is recommended). It is preferable to use tailgate lifts to eliminate lifting altogether.

A.5.1.6.4 Wheel Chairs/Shower Chairs. Wheel chairs and shower chairs are devices used for transporting a partially ambulatory patient in a seated posture. Shower chairs are used specifically for toileting and showering.

Appropriate features for these devices are heavily dependent upon how the device will be used (e.g., home environment, transport, emergency, long-term use, etc.). However, the general features that are important for all uses include the following:

- Provide height adjustable and removable arms to assist in patient transfers

- Provide foot supports which fold out of the way during ingress and egress

- Provide wheels that are easy to lock/unlock, yet difficult to unlock inadvertently

A.5.1.6.5 Lifting Belts. Lifting belts are devices that wrap around the mid-section of the patient and improve the staff member's ability to grasp the patient effectively (Figure A.17). Lifting belts can be used in patient transfers where the patient is capable of assisting in the transfer. Lifting belts are often used for ambulation and other patient movements to encourage the patient to perform the actions independently, or to build or maintain muscle strength.

Caution should be used with lifting belts (and manual transfers in general). If the patient loses strength or control mid-transfer, the staff member may be forced to suddenly bear the entire weight of the patient. This can result in an acute injury for the staff member and/or the patient. Use of lifting belts should be minimized, in general, and only used in specific situations where the patient's condition and abilities are stable and known. Mechanical ambulation assist devices (also called "walkers") are generally preferred for tasks where the patient's condition is less than completely understood and reliable.

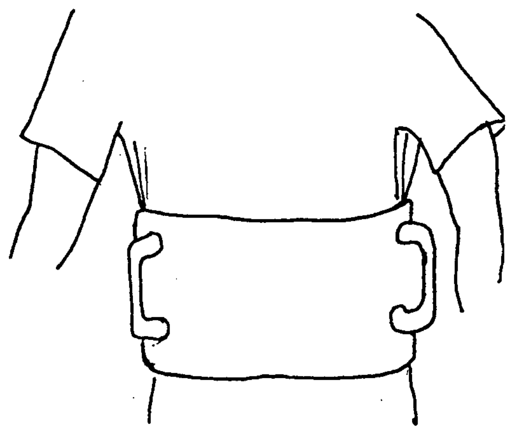


Figure A.17
Lifting Belt

The following features should be considered in lifting belts:

- Provide belts that are at least 6" (15 cm) wide to provide a larger surface area to support the patient without slipping.
- Provide belts that have a high friction surface facing the patient's body to minimize slipping.
- Provide belts that have soft, padded edges to prevent scraping or bruising the patient.
- Provide belts with built-in full-grip handles that are between 1 and 1.5" (2.5-3.8 cm) in diameter and at least 5" (12.7 cm) in length. The handles should be made of a rubberized, high-friction material and should be rounded to avoid hard edges.

A.5.1.6.6 Patient Handling Device Evaluation Worksheet. Table A-5 presents a worksheet to determine whether a patient handling device has basic ergonomic features. This worksheet is provided assist in the systematic evaluation of various products. The first part of the worksheet (criteria marked with asterisks) applies to most or all of these devices. This is followed by criteria for specific types of devices.

Table A-7
Patient Handling Device Evaluation Worksheet

Date:			**Evaluator:**			
Job:			**Type:**			
Manufacturer:			**Model Number:**			
Model Name:			**Price:**			
Category	**Parameter**	**Measure**	**Meets Criteria**		**N/A**
			Yes	**No**	
General Safety Requirements	Stability*	Device must be stable throughout the transfer and must be resistant to tipping even if the patient is moving.			
	Moving Internal Components*	Device should not have any exposed moving components that could create pinch or crush hazards. All moving components that could result in a pinch/crush hazard should be guarded.			
	Hard/Sharp Edges*	Device should not have any exposed hard or sharp edges that could result in a cut or scrape.			
Overall Capabilities	Capacity*	Capacity of the device should exceed the heaviest patients.			
	Space Efficiency*	Device must fit into the space required by the task.			
	Posture Requirements*	Device should encourage comfortable and neutral body postures during use. It should not contribute to bent wrists, reaching, and awkward back/neck postures for the patient or staff.			
Ease of Use	Overall*	Device adjustments should be easy to operate and should not increase task time significantly.			
	Mobility*	Device should be easy to maneuver without loss of control or stability.			
	Cleanability*	Device should be easy to clean.			
	Control understand-ability*	Controls used to operate the device should be easy to identify, understand, and actuate.			
Force Requirements	Transporta-tion Forces*	Forces required to manually push the device should be less than 25 lbs. (11.3 kg.) Negligible forces are recommended when appropriate.			
	Control Actuation Forces*	Controls that require constant pressure to allow operation should not require a significant amount of force. Forces should be substantially less than 2 lb. (0.9 kg.).			

Table A-7
Patient Handling Device Evaluation Worksheet (Cont'd.)

Date:			**Evaluator:**		
Job:			**Type:**		
Manufacturer:			**Model Number:**		
Model Name:			**Price:**		
Category	**Parameter**	**Measure**	**Meets Criteria Yes**	**No**	**N/A**
Handles	Handle Existence*	Devices should have "full-hand grip" handles when: · forces are significant. · control is critical.			
	Handle Orientation*	Handles are vertically oriented (in most situations, horizontal handles are also acceptable and may be preferred in specific circumstances).			
	Diameter*	1-1.5" (2.5-3.8 cm.).			
	Clearance Under Handle*	There should be at least 4" (10.2 cm.) hand clearance between the handle and the mounting surface.			
	Handle Length*	Minimum 5" (12.7 cm.). Longer handles are generally preferred to increase flexibility.			
	Handle Composition*	Handles should be covered with a high friction, rubberized surface.			
Criteria for Mechanical Lift Assist Devices	Sling Connections	Connecting/disconnecting the patient to/from the lift device should be quick, simple, and easy. There should be no possibilities for sling attachments to release during transfer.			
	Single Person Operation	Device should allow safe operation by one person (particularly if the corresponding manual task is performed by one person).			
	Wheel Locks	It should be possible to lock the lift device in position during sling attachment/detachment.			
	Range of the Height Adjustment	The range of adjustment should allow patients to be lifted from floor level to more than 45" (114.3 cm).			
	Integrated Scales	Consider scales integrated into the lift device to eliminate unnecessary lifts.			

Table A-7
Patient Handling Device Evaluation Worksheet (Cont'd.)

Date:			**Evaluator:**		
Job:			**Type:**		
Manufacturer:			**Model Number:**		
Model Name:			**Price:**		
Category	**Parameter**	**Measure**	**Meets Criteria**		**N/A**
			Yes	**No**	
Criteria for Horizontal Transfer Devices	Thickness	Thickness less than 0.25" (0.64 cm) is preferred to minimize the amount of patient movement required to place and remove the device.			
	Forces	Minimize frictional forces by providing a low friction surface.			
	Capacity	Device should have the capacity to support weight of the heaviest patient.			
	Size	Device should support patient's entire body when possible. Provide multiple sizes for children and adults.			
	Weight	Device should be light in weight (i.e., less than 5 lb.).			
Criteria for Gurneys/ Stretchers	Rollability	Device should be easy to roll on the highest friction surface (e.g., carpet).			
	Modes of movement	Device should have a mode for traveling straight down long hallways and another mode for maneuvering in tight spaces.			
	Side Rails	Side rails should be easily adjustable, yet difficult to inadvertently lower.			
	Height Adjustability	Device should be easily height adjustable to allow efficient transfers of patients to fixed-height tables.			
	Loading/ Unloading Ambulances	Forces required to load/unload device from ambulance should not exceed 50 lb. (22.7 kg.) per person (less than 25 lb. or 11.3 kg. is preferred).			
Criteria for Wheelchairs/ Shower Chairs	Chair Arms	Chair arms should be height adjustable and removable to assist in patient transfers.			
	Foot Supports	Foot supports should fold out of the way to assist in patient transfers.			
	Wheel Locks	Wheels should be easy to lock/unlock, but difficult to unlock inadvertently.			

Table A-7
Patient Handling Device Evaluation Worksheet (Cont'd.)

Date:			**Evaluator:**		
Job:			**Type:**		
Manufacturer:			**Model Number:**		
Model Name:			**Price:**		
Category	**Parameter**	**Measure**	**Meets Criteria Yes**	**No**	**N/A**
Criteria for Lifting Belts	Size/Width	Belts should be at least 6" (15 cm) wide to cover a larger surface area.			
	Composition	Belts should have a high friction inner surface and soft, padded edges.			
	Handles	Belts should have built in full-grip handles (see the handle criteria above for more information).			
Comments:					

IMPLEMENTING MINOR MODIFICATIONS

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A.5.2 IMPLEMENTING MINOR MODIFICATIONS

This section provides the user with additional information about the corrective actions recommended in the Case Studies.

A.5.2.1 General Considerations and Approach

When modifying the workstation, tools, or equipment at a work area, it is important to consider all of the tasks that may be impacted by that modification. The following are important considerations:

- Keep the work area flexible.
- Avoid creating a different type of safety hazard.
- Make sure that materials used are appropriate for the area (e.g., special considerations for sterile areas).
- Rely on employees to help identify quick-fix improvement possibilities.

Whenever possible, try to build in adjustability and flexibility at the workstation to enable a number of employees to perform a variety of tasks comfortably. For example, an individual who is 5'2" will have different requirements for work surface height (lower to the ground) than a fellow employee who is 6'0". Adjustability enables each employee to adapt the work area to suit his/her specific needs. It is also important to avoid creating a maintenance or other safety hazard. For example, constructing a platform that is "too small" may create a tripping or fall hazard. Similarly, placing a piece of anti-fatigue matting in a high traffic area may create a tripping hazard.

Employee input is important to ensure the effectiveness of proposed modifications. To maximize the effectiveness of employee input and avoid creating false expectations, the following approach is recommended:

- Define the specific issue to be addressed (e.g., reduce the number of times the employee must lift an object, reduce the degree of bending, etc.).
- State that, "at this time" the changes will be limited to adjusting or making better use of the current work area, work platforms, or equipment (i.e., new purchases of new equipment can be suggested, but will not be evaluated until the next budgeting period).
- Remind employees that, since they are all different, an adjustment that works for one of them may not be appropriate for the others.

A.5.2.2 Improving Existing Tools

The purpose of modifying existing tools is to minimize discomfort and the potential for WMSDs. When considering changes to an existing tool, it is important to consider the task being performed, the size of the employee's hand, and the "safeness" of changing a feature of the tool. For example, padding may be added to wrap and build-up a tool handle diameter that is too small for an employee. However, if the padding is loosely fit and the tool will be used around moving equipment, the padding may create a safety hazard. A better solution may be to add a slip-on rubber sleeve.

A.5.2.2.1 Tool Maintenance. Maintaining or servicing existing tools is often a good starting point for improving tool performance and employee comfort. The following factors should be considered:

- Tool blades, grinding stones, and bits should be checked regularly and replaced when necessary to ensure that they are sharp for optimum performance. A dull bit or blade will impact the quality of finish and often requires the employee to work longer on the task to achieve the desired outcome. Maintenance of blades, bits, and grinding stones may be done in the immediate work area according to a maintenance or replacement schedule (provided by the supplier or manufacturer). In some cases, the tool may have to be sent to the manufacturer for precise maintenance routines (replacement tools may be provided).

- Motors should be regularly serviced and lubrication should be performed as specified by the manufacturer of the tool.

- Tool balancers should be regularly adjusted to balance the weight of the tool. Adjustment is required when the employee appears to be pulling the tool ("fighting the pull"). When a tool is not balanced, the weight of the tool must be leveraged by the user to keep it balanced. This increases fatigue and affects the quality of the work.

A.5.2.2.2 Handle Diameter. Establishing the optimum diameter maximizes the strength of the hand. A properly sized tool will reduce grip force requirements. The optimum handle diameter is between 1.5 and 2.2" (3.8-5.6 cm.). Select the most appropriate handle diameter that will fit the employee. Increasing the handle diameter can be accomplished using sponge padding or commercial grips. It is important that the adaptation is secure and fits snugly around the handle. The material added should take into account the thickness of gloves that the employee typically wears.

A.5.2.2.3 Handle Length. Handle length may be increased to reduce pressure points in the palm or to increase the mechanical advantage. The following factors are important considerations:

- The recommended minimum handle length is 5" (12.7 cm.). It is important that handles extend past the palm as illustrated in Figure A.4.

- Adapting a tool that is too short can be accomplished by welding an extension to a steel handle. If this is done, ensure that all edges are smooth and the extension is integrated (in line) with the previous handle. Wooden and plastic handles are very difficult to adapt since there is no secure method to add additional material. For tools made of these materials, employees have sometimes used special purpose tape and wooden extensions. It may be possible to order a new longer handle from the manufacturer.

- Adaptation also can be accomplished by purchasing an inexpensive commercial handle that meets the specification for length and diameter. This method will be a more feasible solution for such tools as hammers. Commercial handles may be available for power tools but in most cases a tool upgrade will have to be examined as the best alternative.

A.5.2.2.4 Air Hose Connection. An appropriate connection can decrease grip force requirements. Use a swivel or universal joint connector to minimize drag on the hose. Another option is to fabricate a simple hanger (like an "I.V." tube stand) to elevate and support air hoses. The hanger will also reduce drag along the floor and make the tool easier to position.

A.5.2.3 Getting Closer to the Work

The individual should get as close as possible to the work to avoid excessive reaching. Removal of obstructions from the work area can often solve problems associated with reaching.

A.5.2.3.1 Remove Obstructions from the Floor. Poor housekeeping is often the main contributor to obstacles in the work area. To keep the employee as close to the work as possible, the following actions may be helpful:

- Help the worker identify and remove obstructions from the floor such as air hoses, boxes, tools, and carts.

- Maintain a clean work area and store items as necessary in designated storage areas.

A.5.2.3.2 Remove Obstructions between the Worker and the Work. There are several strategies that avoid obstructing the work area:

- Remove any part or panel in front of the area that needs to be accessed prior to working inside the area.
- Reorient the work piece or investigate the feasibility of modifying the fixture if any fixture or part restricts access (e.g., removing or relocating a panel or kick-plate).
- Lower a work platform (when used) to provide clear access under the work and allow the employee to stand up straight while moving within the work area or while servicing the part.

A.5.2.3.3 Reduce Congestion by Providing Appropriate Aisles. To reduce congestion in warehouse applications, consider the following aisle guidelines for one way flow:

- For trackers, the aisle width should be at least 12' (3.66 m)
- For 1-ton to 3-ton fork trucks, the aisle space should range from 9 to 11' (2.74-3.35m)
- For narrow aisle trucks, the aisle width should be 6' (1.83 m)
- For manual platform trucks, the aisle width should be 5' (1.5 m)

A.5.2.4 Adding Variety to the Work Position

One of the most effective strategies for improving comfort and preventing fatigue in the lower back and legs is to provide task variety by alternating standing and seated tasks. The factors for consideration when helping employees identify (or confirm) which of their tasks might be done best from a seated position and which might be done best from a standing position are delineated below.

A.5.2.4.1 Sitting. The desirable seated posture is shown in Figure A.18. Sitting is most appropriate when the following conditions are present:

- All items needed for the task can be easily accessed and handled within the seated work place.
- No large forces (such as handling heavy objects) are required .

- Precise assembly is required.

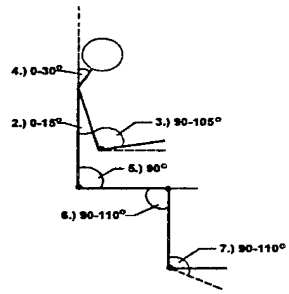

Figure A.18
Recommended Seated Posture

Although many chairs have built in adjustments, examples of additional enhancements are:

- Taping a rolled up towel to the backrest to increase the lumbar support.

- Taping foam or other compressible surfaces around the armrest until the surface matches the width guideline.

For chair selection criteria, refer to Appendix 5, *Design Criteria*, of the Administrative Guide.

A.5.2.4.2 Standing Posture. The desirable standing posture is shown in Figure A.19. Standing is most appropriate when the following conditions are present:

- A greater range of movement is required for reaching
- It is not appropriate or possible to allow knee room
- The point of operation can't be lowered (for sitting)

Although standing has the advantage of providing for a greater range of motion, it has the disadvantage of placing stress on the back and legs, and causing pooling of blood in the lower legs. Employees should be encouraged to avoid locking their knees and to walk or move around periodically to prevent static muscular fatigue. Employees should also be encouraged to use cushioned shoe inserts (e.g., sorbothane material or other impact/shock-absorbing material).

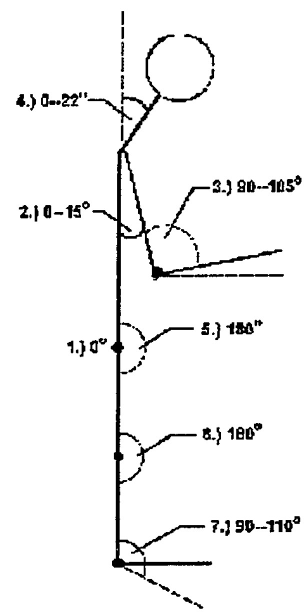

Figure A.19
Recommended Standing Posture

A.5.2.5 Improving the Work Height

Improving the work height can result in significant improvements to low back, shoulder, and, in some cases, wrist comfort. It is not simply a matter of raising or lowering the work. The relationship between the height of the employee and the height of the primary work location should be optimized

A.5.2.5.1 Single-Employee Workbench. When only one employee uses a workstation or bench, the best approach is to help the employee customize his/her work area. The following items should be considered:

- Establish height so the worktable is low enough to handle the largest work piece and allows the employee to work in a neutral position. (For aircraft, establish the work platform so the employee can work on the lowest point from a comfortable seated or standing position. Higher points of work can be reached using additional [stable] risers.)

- Build simple tabletop risers out of wood or a similar material to increase the effective work height for smaller/shorter work pieces.

- Raise the height for taller employees by putting table legs on blocks.

- Lower the height for shorter employees by cutting the legs of the current tables, or by adjusting the leg height if the table has adjustable leg extenders.

A.5.2.5.2 Multiple-Employee Workbench. When more than one employee must use the work area, the following consideration allows for maximum flexibility:

- If the worktable is a fixed height, set it up for taller employees (i.e., raise the table up on blocks) and then provide a stable platform for shorter employees.

A.5.2.5.3 Fixed Position Point of Operations (e.g., Aircraft). In operations where the point of operation cannot be changed, consider the following:

- Add temporary, stable risers for shorter employees who work on elevated platforms.

- Use a stool or chair for work that may be too low for comfortable standing work.

A.5.2.5.4 Table and Counter Heights. Appropriate table and counter heights depend on the nature of the task and the height of the worker. To create small increments of vertical height adjustment, consider using pegs and pre-drilled holes in the legs, or providing electric or mechanical systems. To prevent awkward back postures and reduce visual stress, consider the following general guidelines for table and counter heights:

- Angle the work surface 15° forward for standing tasks requiring visual inspection.

- Set the workstation to adjust between 39 and 43" (99-109 cm) for precision tasks (drafting and fine soldering).

- Set the workstation to adjust between 35 and 37" (88-94 cm) for tasks requiring "light work" (assembly of small parts).

- Set the workstation to adjust between 29 and 35" (74-89 cm) for tasks requiring "heavy work" (drilling or molding).

A.5.2.6 Improving Comfort with Foot Pedal Use

Considerations for improving comfort with foot pedal use in both seated and standing tasks are discussed in the following subsections.

A.5.2.6.1 Standing Work. The primary objective of appropriate foot pedal design is to prevent the employee from maintaining a "flamingo" or single-leg stance. The main concern is for employees who use foot pedals for a significant part of the shift. The following modifications should be considered:

- Build up a simple platform riser and place the foot pedal off the front surface so both heels are on the platform and the action of the foot is down (keep a 90-120° angle between the foot and the lower leg). To provide adequate leg room, remove obstructions to allow a distance of at least 10 inches between the end of the foot and the closest vertical surface.

- Add a heel riser (block of wood) to the heel end of the foot pedal. This option may not be as effective as the first one, but it will help to distribute body weight more evenly across both legs and the back muscles.

A.5.2.6.2 Seated Work. The primary objective is to keep the feet and legs in the neutral position. Most foot pedals (with the exception of vehicles) can be re-positioned. The guidelines are presented below.

- Foot pedal stability is critical. Add a non-slip surface or a weight to the base of the foot pedal to increase stability.

- The foot pedal should be height, angle, and horizontally adjustable to accommodate multiple employees. Build a riser out of wood to place under the foot pedal to provide height adjustability.

- Foot pedal side-to-side position and distance away from the body should be adjusted to maintain angles of 100-110° between the back and the thigh and the lower leg, as well as 100-110° between the foot and the lower leg. Both legs should be centered with the body.

A.5.2.7 Reducing the Demands of Manual Handling

Manual materials handling (MMH) is one of the most important aspects of work to which ergonomic principles should be applied, particularly in the prevention of low back pain and injuries. Manual materials handling involves the general types of activities illustrated in Figure A.20.

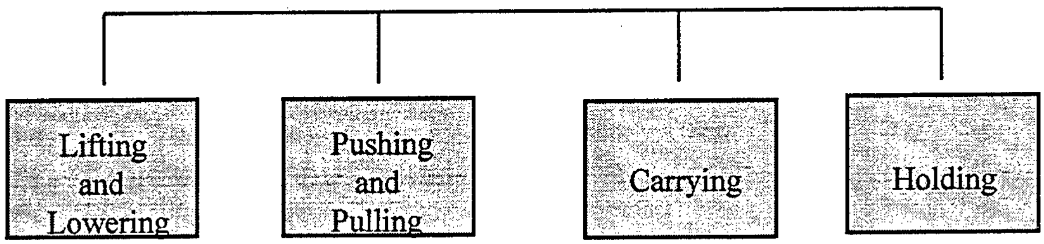

Figure A.20
Manual Materials Handling Activities

Typically, MMH tasks in warehouse and service areas require the worker to perform a combination of the above activities. The ability of the employee to handle materials safely is a function of the following factors:

- Task characteristics.
- Material/container characteristics.
- Worker or handling characteristics.

A.5.2.7.1 Task Characteristics. Consider the following when identifying the types of modifications that can be made to reduce exposure to risk factors:

- Reduce twisting motions by re-organizing the work area to provide sufficient space for the entire body to turn when handling items or when pushing or pulling carts.
- Reduce excessive forces by encouraging the employee to use available mechanical aids such as hoists and cranes. If aids are difficult to use, make a note of the reasons why and communicate this information to the shop supervisor or shop mechanic. It may be possible that a repair or minor modification to the hoist may make it easier to use.
- Limit stacking of lightweight objects to shoulder height.
- Keep heavy objects at knuckle height.

- Keep wheels on carts well maintained.

- Keep objects close to the body when lifting or carrying.

- Distribute tools evenly on both sides of a tool belt. Encourage the employee to remove the tool belt and place it on a small worktable, whenever possible. The goal is to avoid having the tool belt (especially if the weight is unevenly distributed) place an additional load on the spine and muscles of the back.

A.5.2.7.2 Material/Container Characteristics. Consider the following when identifying the types of modifications that can reduce exposure to risk factors:

- Reduce excessive forces by distributing the weight/items evenly in a container.

- Use containers with handles whenever possible.

- Use the minimum size and lightest weight container possible for transferring loads.

- Place containers on carts and push the cart instead of carrying the load.

- Add wheels to small, heavy containers and use a hook to drag/roll them across the floor.

- Clearly label the container or item with its correct weight to help employees to decide how to handle the material.

A.5.2.7.3 Worker and Handling Characteristics. Consider the following when identifying the types of modifications that can be made to reduce exposure to risk factors:

- Maintain a straight back when lifting, using the leg muscles to lower the body and lift the load.

- Keep the body balanced.

- Turn with the feet rather than twist the trunk when lifting or transferring loads.

- Share the load/lift with another employee (buddy lift).

- Avoid quick movements when two people are lifting an object, and make sure both employees have a firm hand hold before starting the lift. Lift the load with a smooth body motion.

- Keep the load as close to the body as possible when lifting.
- Avoid overloading carts.
- Know the weight of the load being lifted. Make sure when using the buddy lift that both people can handle the load. Do not proceed with the lift if one employee is straining to maintain the lift.
- Alternate handling heavy loads with light loads, whenever possible.

A.5.2.8 Reducing Effects of Vibration

Vibrations are mechanical oscillations produced by either regular or irregular periodic movements of a body about its resting position. Vibration is characterized by its frequency, acceleration, and direction. Persons in direct contact with vibrating objects or surfaces may be at risk.

The two types of human vibration exposure are whole-body vibration and hand/arm (segmental) vibration:

- Whole-body vibration is transmitted to the "whole body" usually through the surface that supports the weight of the body. A worker who drives a vehicle is subjected to whole-body vibration through the buttocks and back, if a backrest is used.
- Hand/arm or segmental vibration is vibration transmitted to the hands and arms, generally from hand-held power tools.

The whole body can be considered to be a dynamic mechanical system. Each part of that system (body segment) resonates at a different frequency. Vibrations are "absorbed" by the tissues and organs. Depending on the frequency of the vibration and overall exposure, localized muscle fatigue and even damage to other tissue can occur.

A.5.2.8.1 Provide Anti-vibration Gloves. Anti-vibration gloves attempt to control the transmission of vibration by providing a dampening surface between the tool and the employee. Many times, providing gloves is a more effective solution than damping the tool because gloves are able to protect against cuts and lacerations, provide an effective dampening media, and do not increase the tool's handle diameter. Care must be taken to ensure that glove use does not make an otherwise appropriate handle "too large". Additionally, anti-vibration gloves are available in a variety of glove sizes and types (e.g., full-hand, fingerless), making them suitable for many applications.

A.5.2.8.2 Attach Anti-vibration Adhesive Surfaces. See A.5.2.2.5

A.5.2.8.3 Perform Periodic Maintenance. One cause of vibration-type disorders is due to poor tool or equipment preventative maintenance (PM). Lack of PM results in more vibration being transmitted to the employee than intended. Please see Section A.5.2.1.2 and consult the equipment manufacturer regarding maintenance schedules.

A.5.2.9 Modifying Work Areas to Improve Employee Comfort

The following sections deal with modifying existing work areas to allow for employee comfort.

A.5.2.9.1 Provide Support for the Lower Limbs – Footrests and Footrails. When considering methods for providing support for the lower limbs, consider providing footrests and footrails with the following dimensions:

- The footrest's front edge should be approximately 14" (35.6 cm) and rise at an angle of 10°.
- The footrail's front edge should be level and the diameter should be at least 5" (12.7 cm).

A.5.2.9.2 Provide Undersurface Cut-ins (Toe Spaces). Undersurface cut-ins (toe spaces) allow employees to maintain a neutral back position when standing at counters.

- Toe space height and depth should each be 4" (10.2 cm.).

A.5.2.9.3 Reduce Effects of External Trauma. Resting on hard or sharp edges to support an upper limb is one source of upper limb trauma.

- For tasks that require hand stability and visual access, cover edges with compressible padding to support the upper limb.

A.5.2.9.4 Provide Knee Space for Seated Tasks. It is essential to provide enough space under a surface so that the legs and feet have angle room to move.

- The most important consideration is knee clearance, or the distance between the knees and any object (e.g., table leg, trash can). If the design allows enough room for the legs of a tall male (95th percentile), then the space will also be comfortable for smaller workers.

- When a person is in a sitting position there should be a distance of 39" (99 cm.) from the back of the buttocks to the closest object. Additionally, if the task or job requires that the person turns and places objects on adjacent work surfaces, a 39" (99 cm.) pivoting radius should be provided.

A.5.2.9.5 Provide Anti-fatigue Matting for Standing Work Areas. Prolonged standing without movement can result in the pooling of blood in the lower limbs. Therefore it is essential that anti-fatigue matting be provided at work areas where employees stand while completing their tasks (e.g., checkout counter, meat cutting).

- Depending on the work environment there are different materials and surfaces available. For instance, in food preparation environments, it is essential that the matting have perforations that allow for constant cleaning and rinsing; in industrial environments that involve cutting of metals, durable surfaces are required to prevent metal shards from becoming imbedded.

- The size for anti-fatigue matting is dependent upon the task demands. For tasks that involve standing at a single workstation, ensure that the anti-fatigue matting is at least 24" X 36" (61–91 cm.).

- Appropriate anti-fatigue matting should be replaced approximately every 18 months or less depending on traffic. Additionally, ensure that the matting is no more than 1.5" (3.81 cm.) thick and has beveled edges to prevent potential trip hazards from occurring.

A.5.2.10 Modifying the Work Area to Reduce Visual Demands

Eyestrain is most commonly caused by exposure to excessive or inadequate amounts of light. The sources of eyestrain can include natural (e.g., sun) or artificial (e.g., task lighting) sources. It is possible to reduce eyestrain by modifying existing work areas or providing the appropriate amount of light.

A.5.2.10.1 Reduce Exposure to Glare Caused by Light Sources, Work Surfaces, and Work Surface Orientation or Location. To arrange work surfaces with the intent of minimizing glare, it is important to consider the following:

- When arranging a work surface, locate the sources of overhead light. If a computer is used, place the screen between overhead light sources and perpendicular to the window. Additionally, ensure that the monitor's face is not tilted upwards to prevent glare from the overhead lighting system. If task lights are present, then ensure that they are placed to focus only on the work area and not on the monitor's surface.

A.5.2.10.2 Provide Appropriate Lighting Based Upon Task Demands. Visual demands can be reduced by providing the correct amount of overhead lighting:

- 150 fc for computer based tasks (this can be accomplished with task lighting).
- 50-75 fc for palletizing-type tasks.
- 50-75 fc for baking and kitchen tasks and 50 fc for general illumination.

(Note: The foot-candle measurement should be taken at the surface or point where the work is performed.)

A.5.2.11 Provide Appropriate Gloves

Gloves are used to increase ease of gripping and prevent exposure to risk factors (e.g., chemical or biological). Improperly fitting gloves can result in increased hand stress.

A.5.2.11.1 Glove Texture, Materials, Size, and Task Demands. The following should be considered when purchasing gloves for warehouse and service area environments:

- For tasks that require gripping of boxes or large objects, consider gloves with high friction surfaces to decrease grip forces.
- For tasks which require latex gloves, provide two types: those with powdered lining and those without powdered linings as a means for preventing allergic reactions. Additionally, if double gloving is required, a larger size outer glove should be worn to reduce hand constriction.
- Consider purchasing gloves that are "handed" as a means for providing a more appropriate fit and that are sized numerically rather than small, medium, or large.

A.5.2.12 Patient Handling Equipment

There are a number of ways to reduce the physical demands of patient handling. The following section describes many of these considerations.

A.5.2.12.1 Mechanical Lifting Equipment. A mechanical lift device should be used whenever possible to handle a patient who needs assistance. Even lifting children can lead to WMSD's when the staff member is in an awkward posture. The overall goal is to work towards a "zero-lift" environment, in which staff do not manually lift patients. The following should be considered:

- Use a lift device to complete patient transfers whenever possible. There are two basic types of sling lift devices available: sitting sling lifts and standing sling lifts (see Section A.5.1.6.1). The standing/upright lifts are quicker and easier to use than sitting sling lifts because the sling is secured only around the patient's upper body (rather than going underneath the entire patient). Standing sling lifts are preferred for more independent patients. However, standing lift devices generally require that patients have some upper body functionality and some weight-bearing capabilities in their legs. Sitting sling lifts are necessary for more dependent patients.

- Share the following information with the staff who use the lift devices:

  - Store lifting devices adjacent to common patient handling areas and ensure that adequate lift devices are available to meet workload requirements.

  - Explain to patients that mechanical lifting equipment is more comfortable for them and helps to prevent staff injuries. Ask for their assistance in completing the transfer.

  - Be sure to secure the sling prior to initiating the lift.

  - Move the lift device as close as possible to minimize reaching. Step close to the patient to further reduce reaching. Adjust the bed height to minimize bending while attaching slings.

  - Try to combine transfers to eliminate unnecessary lifts. Use patient scales integrated into lift devices or platform scales to weigh patients.

A.5.2.12.2 Manual Lifting Equipment. There are several devices that can substantially reduce demands in repositioning and transferring patients. Consider the following suggestions:

- When transferring patients between beds and stretchers, use a sliding board and a large draw sheet. A slider board is a large, flat, plastic board that reduces the friction of sliding the patient (see Section A.5.1.5.2). A wide draw sheet can be used to prevent bending and reaching while sliding the patient. A full size top sheet (or two), turned sideways, can serve as an effective draw sheet for this task. Clear the workspace of unnecessary equipment or other obstructions. Raise the bed and equalize the heights of the bed and stretcher. Lock all wheels prior to completing the transfer. Roll up the edge of the draw sheet to obtain a firm grasp. Perform the transfer by stepping and shifting weight rather than with a back movement.

- For repositioning a patient in bed, be sure to raise the bed to a comfortable height. Obtain assistance if necessary. Use a sliding tube when available to reduce sliding friction between the patient and the bed sheets (See Section A.5.1.5.2).

- If mechanical lift devices are not available for patient transfers, use lifting belts to improve the ability to grasp the patient securely. See Section A.5.1.5.5 for more information on Lifting Belts. Obtain assistance in performing transfers if necessary.

A.5.2.12.3 Staff Training and Technique in Patient Handling Tasks. When manually repositioning or transferring patients, there are several guidelines that can reduce the wear and tear on the body. Staff who perform these tasks need the following information:

- The most important consideration while handling patients is to avoid the tendency to rush. Take a deep breath before completing the transfer. Coordinate transfers with other staff members and patients. Initiate the transfer on a count of three. Perform the transfer smoothly. Take the time to complete the transfer safely and effectively.

- It is always better to use the large leg muscles to lift instead of the small muscles of the back. To achieve this, bend the knees and arch the back prior to lifting. Lift by straightening the legs rather than the back. It may be helpful to remember to touch the knees lightly to the side of the bed or wheel chair to make sure they are adequately bent.

- Move in as close to the patient as possible prior to lifting. This will reduce reaching and improve control.

- When rotating, turn with the feet rather than twisting the lower back. Swing one leg and pivot with the other leg. Keep the shoulders in line with the feet.

- When repositioning a patient in bed, work with two or more people, with at least one person standing on each side of the bed. In this way, staff can work together to reduce reaching and bending.

- Prior to completing the transfer, clear the path of travel to prevent obstructions.

- Always attempt to equalize transfer heights as much as possible. Use gravity to assist with the transfer by placing the destination slightly lower than the origin.

- Try to distribute heavy handling tasks throughout the day rather than performing them all at once.

A.5.2.12.4 Patient Training and Education. Enlisting the help of the patient is a powerful strategy for reducing the demands of the task. Staff need the following guidance:

- Understand the patient's capabilities and limitations. Assess the patient's condition immediately prior to the transfer. Ask them how they feel and to tell you immediately if they start to feel weak during the transfer.

- Ask the patient to assist in the transfer whenever possible. Encourage patients to shift to the side of the bed when possible. When moving the patient up in bed, bend the patient's knees and ask them to push with their legs.

- If the patient begins to fall, do not try to support their full weight. Try to guide them slowly to the floor.

LEVEL I ERGONOMICS ASSESSMENT
SUMMARY AND RECOMMENDATIONS
SAMPLE

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LEVEL I ERGONOMICS ASSESSMENT
SUMMARY AND RECOMMENDATIONS

Date (YYMMDD)		Workplace Identifier:	
(use this space for mechanical imprint)		Base DOVER AFB	Organization 96 ABW
		Workplace SURVIVAL	EQUIPMENT
		Bldg. No./Location 306	Room/Area A
		AFSC/Job Series	Job Name

CRITICAL TASKS IN PRIORITY ORDER

Task Name	Task Rating	Body Regions and Ratings (Circle one for each region)				
		Shoulder/Neck	Hands/Wrists/ Arms	Back/Torso	Legs/Feet	Head/Eyes
1. PACKING	High Med	High ~~Med~~	High Med	High Med	High Med	High Med
2. FOLDING /FITTING	High Med	High Med	High Med	High Med	High Med	High Med
3.	High Med	High Med	High Med	High Med	High Med	High Med

OVERALL JOB RATING

RATING: High Medium (Circle one)	PRIORITY BODY REGION: SHOULDER/NECK HAND/WRIST/ARM (circle one) LEGS/FEET BACK/TORSO HEAD /EYES

- Findings are consistent with results from Job Requirements and Physical Demands Survey (Public Health): ☐ Yes ☐ No ☒ N/A
  Comment: INVESTIGATION CONDUCTED IN RESPONSE TO AF OCCUPATIONAL ILLNESS INVESTIGATION

- Findings are consistent with employee reports of discomfort and/or illness: ☒ Yes ☐ No
  Comment: COMPLAINTS OF BACK DISCOMFORT ARE SUPPORTED BY RESULTS

RECOMMENDATION FOR FOLLOW-UP

Modifications and adjustments	Major changes and/or purchases
-Provide appropriate knee protection/knee pads -Provide shoe inserts -require that two employees share the task of lifting raft in and out of packing fixture	-Consider fabricating a simple table to provide an elevated surface for folding raft (keep employees from kneeling on floor) - Consider modifying current packing fixture to tip sideways (roll or slide raft into fixture), tip up to pack, tip back down to unload.
Expected Benefits (Check all that apply) ☐ Health/Safety ☒ Productivity/Quality	Expected Benefits (Check all that apply) ☒ Health/Safety ☒ Productivity/Quality

BEF (Sign) ______________________________

APPENDIX 6

Forms

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SAMPLE LEVEL I ERGONOMICS
ASSESSMENT CHECK LIST

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<table>
<tr><td>Level I Ergonomics Assessment Checklist for Warehouse and Service Areas</td><td>Survey Date (YYMMDD)</td><td>Workplace Identifier:</td><td colspan="2"></td></tr>
<tr><td colspan="2" rowspan="4">(use this space for mechanical imprint)</td><td colspan="2">Base</td><td>Organization</td></tr>
<tr><td colspan="3">Workplace</td></tr>
<tr><td colspan="2">Bldg. No/Location</td><td>Room/Area</td></tr>
<tr><td colspan="3">AFSC/Job Series</td></tr>
<tr><td colspan="2"></td><td colspan="3">Job Name:</td></tr>
<tr><td colspan="5">BEF Technician: ______________________________
Sign</td></tr>
</table>

Part I - Work Content (Description of Tasks Performed)

Technician: ______

Date: ______

For this section, work with the employee to determine those reoccurring jobs/tasks that are most difficult on the body. Ask the employee the following questions:

- "In terms of stress to the body, what are the most difficult, fatiguing jobs/tasks that you do?"
- "Which of those jobs/tasks do you perform on a regular basis (or occur most frequently)?"

Using the Warehouse and Service Areas Task Key List as a reference, write in the task names in the work content matrix below. If the employee mentions tasks which are not included on the Task Key List, write-in the additional tasks in the Task Key List. **Note: If the person mentions several jobs which each have multiple tasks, complete a separate checklist for each job.**

For each task performed, determine the approximate task frequency using the following proportions of job time:

> 50 % (High): The total percentage of work time spent performing the task is greater than 50%.

10-50 % (Moderate): The total percentage of work time spent performing the task is between 10 and 50%.

< 10 % (Low): The total percentage of work time spent performing the task is less than 10%.

For each task, check the most appropriate circle in the Work Content Matrix below to indicate approximate task frequency. If lifting/high force exertions occur in the task, indicate by checking the appropriate circle.

WORK CONTENT MATRIX

Task	Lifting / Exertion Occur in Task	Task Frequency (Check one)		
		(Low) 0-9%	(Moderate) 10-50%.	(High) 51-100%
1.	O	O	O	O
2.	O	O	O	O
3.	O	O	O	O
4.	O	O	O	O
5.	O	O	O	O
6.	O	O	O	O

= Critical tasks are indicated by the shaded boxes in the Work Content Matrix. Critical tasks are tasks which occur greater than 10% of the job time or which involve lifting or high forces.

ONLY COMPLETE THE CHECKLIST FOR CRITICAL TASKS.
LOW FREQUENCY TASKS WITH LIFTING OR EXERTION ARE SCORED AS MODERATE FREQUENCY.

Performance Measures

How is your performance measured? ______

Part I – Work Content (Description of Tasks Performed)

Warehouse and Service Task Key List

1. Bagging
2. Baking
3. Commissary/Meat Cutting
4. Cooking (Food Preparation)
5. Cooking (Short Order Grill)
6. Dishwashing
7. Food Serving
8. Fork Truck Operating (sitting)
9. Fork Truck Operating (standing)
10. Inspect and Repair Support Equipment
11. Loading/Unloading
12. Lubricating
13. Molding
14. Packing/Shipping
15. Palletizing
16. Patient Handling
17. Picking/Stocking
18. Scanning Bar Code Reader (Hand-held)
19. Scanning (Stationary)/Tendering Money
20. Transporting Loads On Non-Powered Carts

22. Lifting

Part II - Checklist, Shoulder / Neck

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

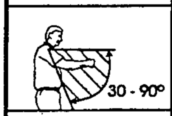
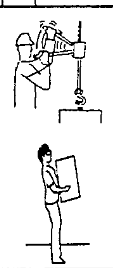
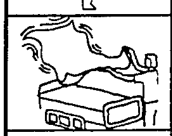
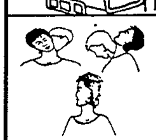
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasionally (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

		Task Name:		Task Name:		Task Name:		Comments
		Task Frequency		Task Frequency		Task Frequency		
	Job Factor	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	
	1. **Reaching** *repeated reaching or arms held continuously away from body while unsupported*							
	*Below shoulder level (arm 30-90° away from body)*	F S O N 1 1 0 0 **OR**	F S O N 3 2 1 0 **OR**	F S O N 1 1 0 0 **OR**	F S O N 3 2 1 0 **OR**	F S O N 1 1 0 0 **OR**	F S O N 3 2 1 0 **OR**	
	*Above shoulder level (arm > 90° away from body)*	F S O N 3 2 1 0	F S O N 4 3 1 0	F S O N 3 2 1 0	F S O N 4 3 1 0	F S O N 3 2 1 0	F S O N 4 3 1 0	
	2. **Arm forces: Repeated arm forces** exceeding 10 lb. (4.5 kg.) *(e.g. roughly equivalent to lifting a gallon of milk)* **or** **Holding/carrying materials** *exceeding 25 lb.(11.3kg.) for more than three steps*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	3. **High speed, sudden shoulder movements** *(e.g., opening a stuck door, pulling and yanking on a bed linens to remove them)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	4. **Head/neck bent, tilted, or twisted** (>10°) *(e.g., scale display too high or too far away from scale)*	F S O N 3 2 1 0	F S O N 6 3 1 0	F S O N 3 2 1 0	F S O N 6 3 1 0	F S O N 3 2 1 0	F S O N 6 3 1 0	
	Task Scores = (column total)							

Part II - Checklist, Hands/Wrists/Arms

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

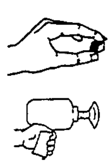
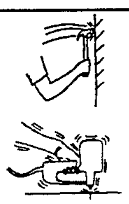
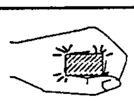
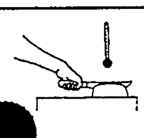
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasionally (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

		Task Name:		Task Name:		Task Name:		Comments
		Task Frequency		Task Frequency		Task Frequency		
	Job Factor	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	
	5. **Bent wrists/repeated wrist movements** (>10° in any direction) or **repeated forearm rotation** *(e.g., scanning groceries, washing dishes)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	6. **Repeated manipulations with fingers** *(e.g., repetitive keying tasks, operating buttons on hand-held scanners)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 1 0 0 0	F S O N 2 1 0 0	
	7. **Hyperextension of finger/thumb** *(e.g., using pliers with a wide handle span)* **or repeated single finger activation** *(e.g., single finger triggers on power tools)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 1 0 0 0	F S O N 3 1 0 0	
	8. **Hand/grip forces** *fingertip force: > 2 lb.(.9 kg.) (e.g., 2 lb. is roughly equal to holding fingernail clippers closed full hand force: > 8 lb. (3.6 kg.) (e.g., 8 lb. is roughly equal to holding a gallon of milk)*	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	
	9. **High speed hand/wrist /arm movements** *(e.g., yank a box open, using a packing tape dispenser)* ***or*** **Vibration, impact, or torque to the hand** *(e.g., using a nail gun)*	F S O N 3 1 0 0	F S O N 5 2 1 0	F S O N 3 1 0 0	F S O N 5 2 1 0	F S O N 3 1 0 0	F S O N 5 2 1 0	
	10. **Exposure to hard edges** *(e.g., tool handle or work area presses into fingers or hand, holding a box by cut-out handles or strapping)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	11. **Hands and fingers exposed to cold temperatures** *(e.g., working outside in winter environment, working in freezers, meatpacking)*	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	Task Scores = (column total)							

Part II - Checklist, Back/Torso

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

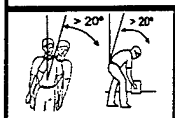
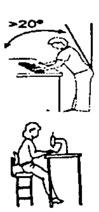
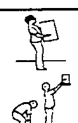
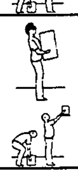
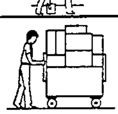
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasionally (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	Task Name:		Task Name:		Task Name:		Comments
		Task Frequency		Task Frequency		Task Frequency		
		Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	
	12. **Repeated forward or side-ways bending movements** (>20°) (e.g. lifting from floor level)	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	13. **Twisting of the lower back** (e.g. rushing while lifting, pulling, open a stuck door)	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	
	14. **High speed, sudden movements** *with the back* **or Handling awkward, uneven or shifting loads,** *(e.g., lifting patients, lifting boxes larger than 30")*	F S O N 3 2 2 0	F S O N 4 3 2 0	F S O N 3 2 2 0	F S O N 4 3 2 0	F S O N 3 2 2 0	F S O N 4 3 2 0	
	15. **Static, awkward back postures** *(for >10 sec at a time)* ***While standing,*** *continuous leaning forward or to the side* (>20°) **or** ***While seated,*** *continuous leaning forward* (>20°) *or poor lower back posture*	F S O N 2 1 0 0	F S O N 6 2 1 0	F S O N 2 1 0 0	F S O N 6 2 1 0	F S O N 2 1 0 0	F S O N 6 2 1 0	
	16. **Lifting forces**							
	• *50-70 lb. (22.7-31.8 kg.) while upright w/ load close to body or* • *10-40 lb. (4.5-18.1 kg.) while bending or reaching*	F S O N 3 2 2 0 **OR**	F S O N 4 3 2 0 **OR**	F S O N 3 2 2 0 **OR**	F S O N 4 3 2 0 **OR**	F S O N 3 2 2 0 **OR**	F S O N 4 3 2 0 **OR**	
	• *> 70 lb.(31.8 kg.) while upright w/ load close to body or* • *> 40 lb. (18.1 kg.) while bending or reaching*	F S O N 6 5 4 0	F S O N 7 6 4 0	F S O N 6 5 4 0	F S O N 7 6 4 0	F S O N 6 5 4 0	F S O N 7 6 4 0	
	17. **Pushing or pulling** *(initial force > 50 lb. (22.7 kg.) (e.g. pushing/pulling a full two-drawer file cabinet across a carpeted floor)*	F S O N 3 2 1 0	F S O N 4 3 2 0	F S O N 3 2 1 0	F S O N 4 3 2 0	F S O N 3 2 1 0	F S O N 4 3 2 0	
	18. **Whole body vibration** *felt through floor surface (e.g. operating a fork truck)*	F S O N 2 1 0 0	F S O N 4 2 1 0	F S O N 2 1 0 0	F S O N 4 2 1 0	F S O N 2 1 0 0	F S O N 4 2 1 0	
	Task Scores = (column total)							

Part II - Checklist, Legs/Feet

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

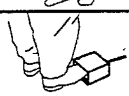
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasionally (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

		Task Name:		Task Name:		Task Name:		Comments
		Task Frequency		Task Frequency		Task Frequency		
	Job Factor	**Moderate 10-50%**	**High 51-100%**	**Moderate 10-50%**	**High 51-100%**	**Moderate 10-50%**	**High 51-100%**	
	19. **Fixed position, standing** *static effort in legs (e.g. standing for prolonged periods)*	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	20. **Exposure to hard edges on legs, knees, and feet** *(e.g., kneeling on a hard surface, leaning against a hard edge, exposure to hard front edge of seat)* **or** **Standing on hard surfaces.**	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	21. **Awkward leg postures** *(e.g. kneeling or squatting)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	22. **Awkward foot postures** *(e.g., using foot pedal while standing, squatting, standing on tip toes)*	F S O N 1 0 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 3 2 1 0	
	Task Scores = (column total)							

Part II - Checklist, Head/Eyes

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

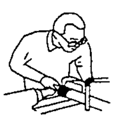
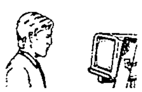
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasionally (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

		Task Name:		Task Name:		Task Name:		Comments
	Job Factor	**Task Frequency**		**Task Frequency**		**Task Frequency**		
		Moderate 10-50%	**High 51-100%**	**Moderate 10-50%**	**High 51-100%**	**Moderate 10-50%**	**High 51-100%**	
	23. **Difficult to see/light levels too low /glare** *(e.g. searching under vehicles for lubrication points)*	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	24. **Intensive visual tasks, staring at work objects for long periods** *(e.g., visual inspection of small parts)*	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	Task Scores = (column total)							

Part III - Environmental

Environmental Factors

	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
25. Restricted space	0	0	0	1	4
26. Extreme temperatures heat/cold	0	0	0	1	4
27. Noise or distractions	0	0	0	1	4
28. Air quality concerns	0	0	0	1	4

Environmental Score =

Environmental Rating	Low	Med	High
Environmental Score	0-3	4-7	8+

Part IV - Employee Suggestion

Ask the employee for any suggestions for corrective actions that they may have.

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ERGONOMIC SUMMARY REPORT

Technician______________________________

Date ______________________________

Job Description

<u>**Scoring Summary**</u>: Transfer scores from individual scoring sheets.

Body Region	Task Scores					Priority Score by Body Region	Priority Rating by Body Region
	Task Name:	**Task Name:**	**Task Name:**	**Task Name:**		**Add across row and divide by # of tasks for average**	High: 8+ Med: 4-7 Low: 0-3
Shoulder/Neck					=		High Med Low
Hand/Wrist/Arm					=		High Med Low
Back/Torso					=		High Med Low
Legs/Feet					=		High Med Low
Head/Eyes					=		High Med Low

Select the highest body region score for each task then circle below for High, Med, Low	Highest Score	Highest Score	Highest Score	Highest Score
High: 8+ Med: 4-7 Low: 0-3	High Med Low	High Med Low	High Med Low	High Med Low

Environmental Rating
High Med Low

Overall	
Highest Priority Score by Body Region	Overall Priority Rating
	High **Med** **Low**

Corrective Action List (Warehouse and Service Areas)

Select the corrective action from the **case studies** pages paying particular attention to the body regions that are primary and secondary concerns. Place a ✓ in the appropriate boxes below as you select from each case study.

Job Factors

Corrective Action	Action Selected		Implementation Reference
	Minor	Major	(Appendix 5)
1. Alternate between sitting and standing tasks			A.5.2.4
2. Avoid high force tasks while seated			A.5.2.4
3. Change a pinch grip to a power grip			
4. Change lifting/carrying task into a rolling or sliding task			A.5.2.7
5. Change posture frequently			A.5.2.4
6. Call for assistance if necessary			
7. Direct cold air away from the hands			A.5.1.2
8. Distribute intensive activities throughout the process			A.5.2.4
9. Eliminate exposure to hard edges			A.5.2.9.3
10. Eliminate need to constantly hold trigger			A.5.1.2
11. Eliminate unnecessary tasks			
12. Encourage appropriate seasonal clothing			
13. Encourage ergonomic work techniques			
14. Encourage person to have visual disorders corrected			
15. Heat metal/material to make more pliable			
16. Improve cleat design			
17. Improve floor condition			
18. Improve visual access to work			A.5.2.10
19. Improve wheel condition			A.5.1.5
20. Incorporate rest pauses			
21. Increase handle length to improve leverage			A.5.1.2
22. Increase light levels			A.5.2.10
23. Increase room temperature			
24. Increase size of work surface			
25. Increase task variety			A.5.2.4
26. Increase weight of work piece			
27. Lower light levels			A.5.2.10
28. Lower the chair			A.5.2.5
29. Lower the handle			A.5.2.2
30. Lower the monitor/screen			
31. Lower the person			A.5.2.5
32. Lower the work piece/work surface			A.5.2.5
33. Maintain bolts and screws			
34. Maintain hand tool/power tools			A.5.2.2
35. Maintain tracks, rollers, and movement mechanisms			
36. Minimize material which must be removed manually			A.5.2.7
37. Modify facilities to decrease handling			
38. Move closer to the work location			A.5.2.3 A.5.2.9
39. Move monitor/screen closer to body			
40. Move monitor/screen further away from body			
41. Move work piece closer to body			

Corrective Action List (Warehouse and Service Areas) Cont'd

Job Factors

Corrective Action	Action Selected: Minor	Action Selected: Major	Implementation Reference (Appendix 5)
42. Obtain patient's assistance			A.5.2.12
43. Place the trigger/switch to allow a comfortable hand/arm position			A.5.1.2
44. Position mouse/input device next to the keyboard			
45. Position the monitor/screen in front of the body			
46. Provide a ball-bearing rotation table			
47. Provide a carrying container for tools/supplies			A.5.2.7
48. Provide a cart			A.5.1.4 A.5.2.7
49. Provide a flat/level keyboard			
50. Provide a foot pedal which requires the correct amount of force to use			A.5.2.6
51. Provide a foot pump			A.5.2.6
52. Provide a footrail or footrest			A.5.2.6
53. Provide a full-sized input device			
54. Provide a high friction gripping surface			A.5.2.2
55. Provide a hook-type tool to pull items			
56. Provide a keyboard which does not require excessive keying forces			
57. Provide a larger worksurface			
58. Provide a lighter weight door			
59. Provide a lighter weight tool			A.5.1.2
60. Provide a magnifying glass			
61. Provide a mechanical lift device			A.5.1.1 A.5.1.6
62. Provide a multi-finger trigger			A.5.1.2
63. Provide a padded, compressible surface to lay on			
64. Provide a padded, compressible surface to sit on			A.5.2.4
65. Provide a palm rest			
66. Provide a power tool			A.5.1.2
67. Provide a powered cart			A.5.1.4
68. Provide a shorter handle to reduce arm movement			A.5.1.2
69. Provide a smaller container			A.5.2.7
70. Provide a spring release mechanism on pliers-type tools			A.5.1.2
71. Provide a storage bag which is easy to pack/unpack			
72. Provide a swivel connection for air hose			A.5.2.2
73. Provide a telephone head set			
74. Provide a tool that minimizes exposure to vibration/impact/torque			A.5.1.2
75. Provide a tool which can be used with both hands			A.5.1.2
76. Provide a tool which requires minimal force to use			A.5.1.2
77. Provide a tool with an appropriate handle angle			A.5.1.2
78. Provide a wheel barrow			A.5.1.4
79. Provide a work surface which is adjustable in height			A.5.1.3 A.5.2.5
80. Provide adequate leg clearance			A.5.2.9
81. Provide adequate toe clearance			A.5.2.9
82. Provide adequate work space			
83. Provide an adjustable height lift table			A.5.1.3

Corrective Action List (Warehouse and Service Areas) Cont'd

Job Factors

Corrective Action	Action Selected Minor	Action Selected Major	Implementation Reference (Appendix 5)
84. Provide an adjustable mirror			
85. Provide an alternative keyboard			
86. Provide an appropriate anti-fatigue mat			A.5.2.9
87. Provide an appropriate chair/stool			
88. Provide an appropriate handle diameter			A.5.1.2 A.5.2.2
89. Provide an appropriate handle grip span on pliers-type tools			A.5.1.2
90. Provide an auxiliary table			
91. Provide anti-vibration materials			A.5.2.2
92. Provide appropriate abrasive material			
93. Provide appropriate gloves			A.5.2.11
94. Provide appropriate handles			A.5.1.2
95. Provide appropriate knee protection			
96. Provide appropriate shoe inserts			
97. Provide appropriate solvent solution			
98. Provide automatic or semi-automatic feed for fasteners			
99. Provide bolt and screw head designs which are durable			
100. Provide computer glasses			
101. Provide controls which do not require excessive forces			
102. Provide displays which are readable and easy to understand			
103. Provide extensions for tools			A.5.2.2

Job Factors

Corrective Action	Action Selected Minor	Action Selected Major	Implementation Reference (Appendix 5)
104. Provide handles with insulating material			A.5.1.2
105. Provide portable heaters			
106. Provide powered assistance for a manual activity			A.5.1.1 A.5.1.3 A.5.1.6
107. Provide powered or mechanical assistance for door			
108. Provide protection from glare from natural light			A.5.2.10
109. Provide protection from glare from overhead lights/ task lights			A.5.2.10
110. Provide shields or barriers from the wind			
111. Provide support for reference documents			
112. Provide support for the arms			A.5.2.9
113. Provide support for the cable or hose			A.5.2.2
114. Provide support for the head			
115. Provide support for the lower back			A.5.2.4
116. Provide support for the tool			A.5.1.2
117. Provide support for the upper body			
118. Provide support for the work piece			A.5.2.5
119. Provide wheels			A.5.1.5
120. Raise the chair			A.5.2.5
121. Raise the handle			A.5.2.2
122. Raise the monitor/screen			
123. Raise the person			A.5.2.5
124. Raise the work piece/work surface			A.5.1.3 A.5.2.5
125. Recess container into work surface			
126. Reduce carry distance			
127. Reduce depth of storage container			A.5.2.7

Corrective Action List (Warehouse and Service Areas) Cont'd

Job Factors

Corrective Action	Action Selected: Minor	Action Selected: Major	Implementation Reference (Appendix 5)
128. Reduce force required to install or remove the component			
129. Reduce number of fasteners used			
130. Reduce the angle a person has to turn to transfer an item			A.5.2.7
131. Reduce weight of work piece			
132. Remove obstructions			A.5.2.3
133. Replace abrasive or cutting material frequently			
134. Replace standing foot pedals with alternative controls			A.5.2.6
135. Reposition foot pedal			A.5.2.6
136. Rotate the work piece			
137. Sharpen blades frequently			
138. Stand to perform task			A.5.2.4
139. Store materials in the same orientation in which they are used			
140. Use alternative fasteners			

Job Factors

Corrective Action	Action Selected: Minor	Action Selected: Major	Implementation Reference (Appendix 5)
141. Use heavy excavation equipment (e.g., back hoes)			
142. Use two or more persons to perform the transfer			A.5.2.7
143. Wear appropriate shoes			
144. Provide a machine/automate			
145. Modify foot pedal			A.5.2.6
146. Angle the worksurface			A.5.2.5
147. Provide an alternate container			A.5.2.7
148. Provide appropriate equipment			A.5.1
149. Provide appropriate tools			A.5.1.2
150. Re-design the work space			A.5.2.9
151. Reduce the weight of the load on the cart			A.5.1.4
152. Relocate the work			
153. Use a desk-based tape dispenser instead of a hand-held dispenser			

LEVEL I ERGONOMICS ASSESSMENT
SUMMARY AND RECOMMENDATIONS

Date (YYMMDD)		Workplace Identifier:	
(use this space for mechanical imprint)		Base	Organization
		Workplace	
		Bldg. No./Location	Room/Area
		AFSC/Job Series	Job Name:

CRITICAL TASKS IN PRIORITY ORDER

Task Name	Task Rating	Body Regions and Ratings (Circle one for each region)				
		Shoulder/Neck	Hands/Wrists/ Arms	Back/Torso	Legs/Feet	Head/Eyes
1.	High Med	High Med	High Med	High Med	High Med	High Med
2.	High Med	High Med	High Med	High Med	High Med	High Med
3.	High Med	High Med	High Med	High Med	High Med	High Med
4.	High Med	High Med	High Med	High Med	High Med	High Med

OVERALL JOB RATING

RATING: High Medium (Circle one)	PRIORITY BODY REGION: SHOULDER/NECK HAND/WRIST/ARM (circle one) LEGS/FEET BACK/TORSO HEAD/EYES

- Findings are consistent with results from Job Requirements and Physical Demands Survey (PHF): ☐ Yes ☐ No ☐ N/A
  Comment:____________________________________

- Findings are consistent with AF Occupational Illness Investigation: ☐ Yes ☐ No ☐ N/A
  Comment:____________________________________

RECOMMENDATIONS FOR FOLLOW-UP

Modifications and adjustments	Major changes and/or purchases
____________________ ____________________ ____________________ ____________________ ____________________	____________________ ____________________ ____________________ ____________________ ____________________
Expected Benefits ☐ Health/Safety (Check all that apply) ☐ Productivity/Quality	Expected Benefits ☐ Health/Safety (Check all that apply) ☐ Productivity/Quality

BEF (Sign) ____________________________________

(FORM)

APPENDIX 7

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